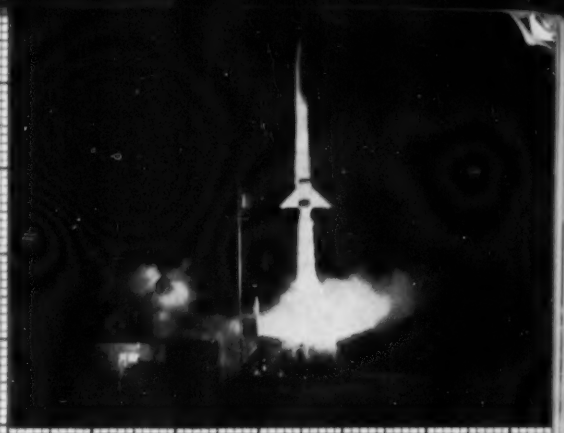
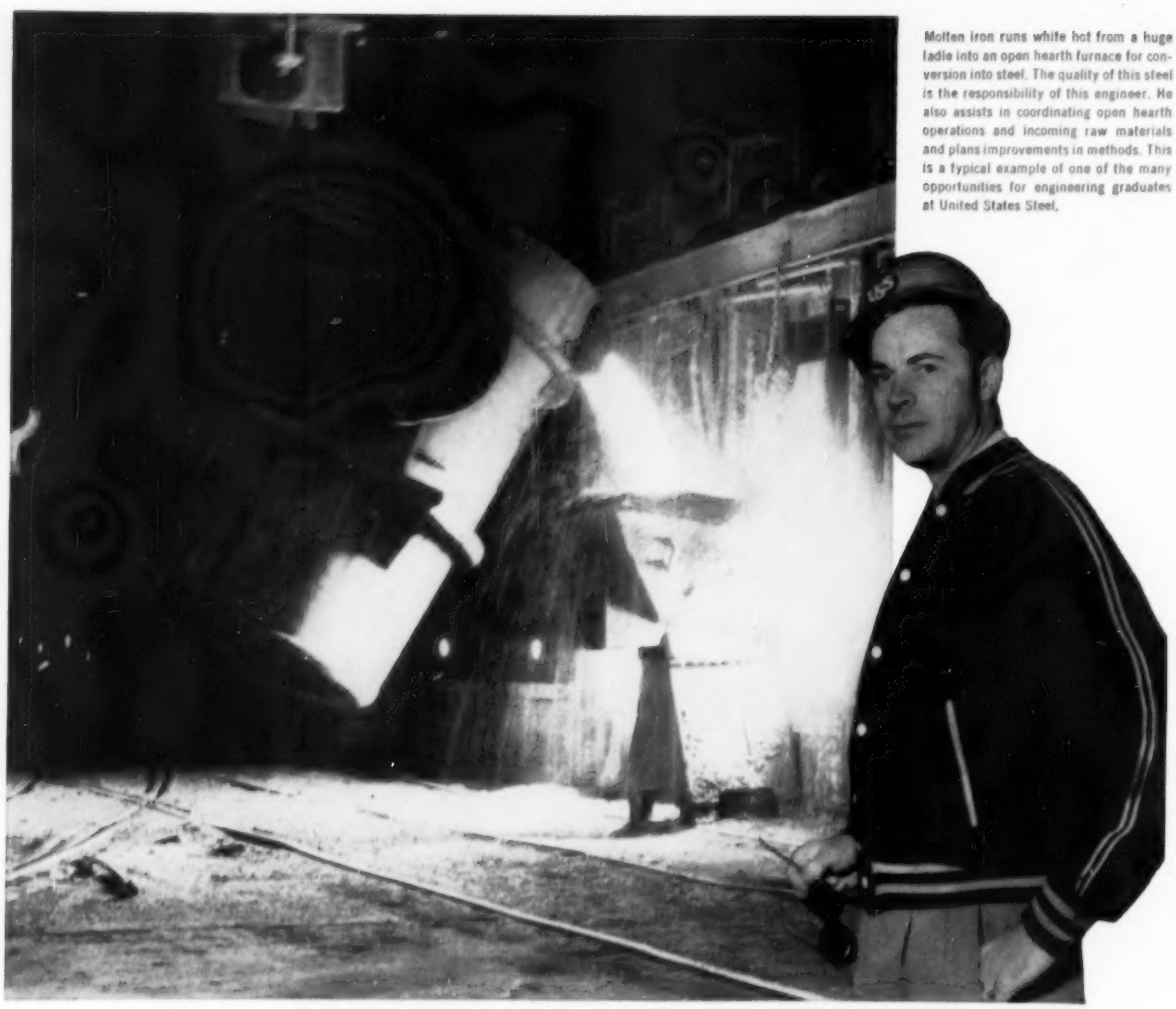


A SPECIAL REPORT

I.G.Y.

The Cornell engineer

NOVEMBER, 1957
VOL. 23, NO. 2
25 CENTS



Molten iron runs white hot from a huge ladle into an open hearth furnace for conversion into steel. The quality of this steel is the responsibility of this engineer. He also assists in coordinating open hearth operations and incoming raw materials and plans improvements in methods. This is a typical example of one of the many opportunities for engineering graduates at United States Steel.

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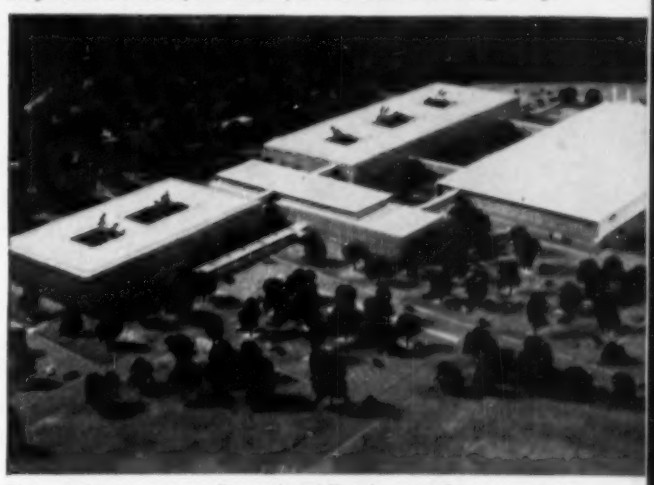
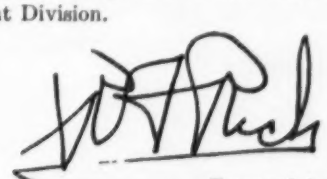
The division is composed of outstanding scientists and engineers who work in an environment that fosters creative investigation. It is the "breakthrough" division of a progressive manufacturing organization. Avco management recognizes the role of the scientist in modern technology. Avco's determination to make things better for America places the resources of a large, diversified, aggressive company firmly behind the Research and Advanced Development Division.



Pictured above is our new Research and Development Center now under construction in Wilmington, Massachusetts. Scheduled for completion in early 1958, this ultramodern laboratory will house the scientific and technical staff of the Avco Research and Advanced Development Division.



Raymond A. Rich
President, Avco Manufacturing Corporation

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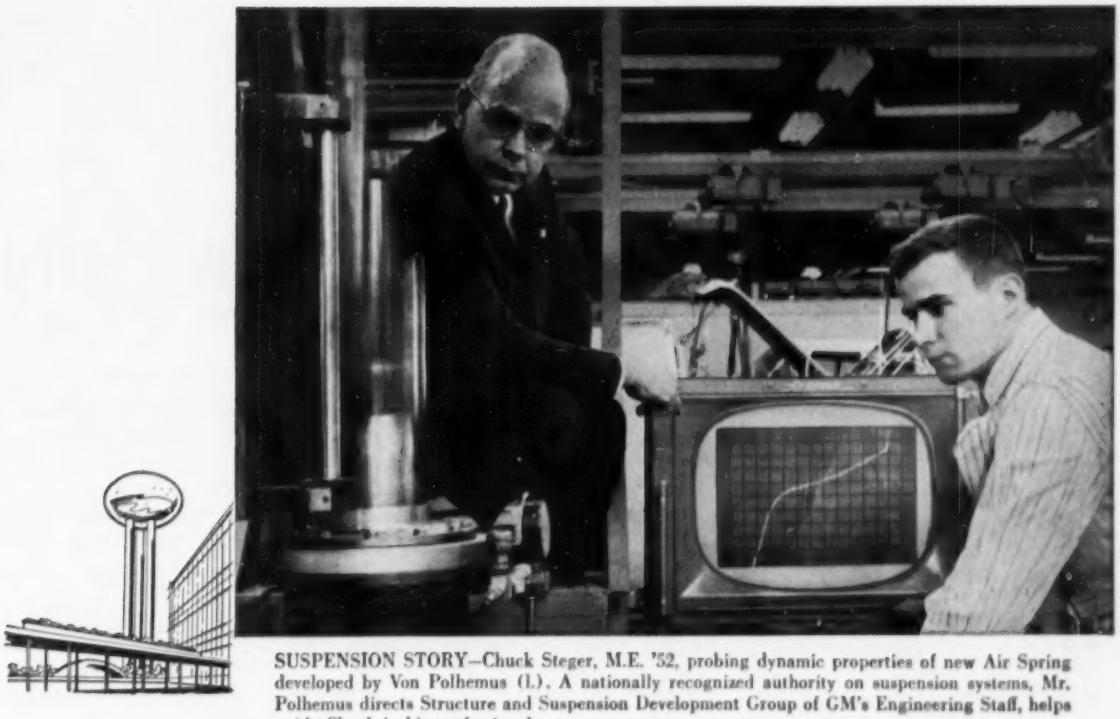

SUSPENSION STORY—Chuck Steger, M.E. '52, probing dynamic properties of new Air Spring developed by Von Polhemus (L). A nationally recognized authority on suspension systems, Mr. Polhemus directs Structure and Suspension Development Group of GM's Engineering Staff, helps guide Chuck in his professional career.

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Editorial . . . . .

I.G.Y.—WONDER and WARNING

As this special International Geophysical Year Issue of the CORNELL ENGINEER went to press, the Soviet Union announced a successful firing of an earth satellite. I.G.Y., as described by student authors on the following pages, represents the achievement of international scientific teamwork for basic research into the wonder of man's foothold in the universe—the earth. I.G.Y., with the reality of the Russian satellite also represents a warning for the free world to reappraise any mistaken beliefs of scientific and technological superiority in the cold war struggle against Communism.

The earth satellite is the most significant I.G.Y. project. The Russians' 184 pound sphere previews the reality of space travel, as man ventures away from his home base to begin a new age of exploration promising to surpass his wildest dreams in terms of intellectual, spiritual, and physical value. The Russians are to be congratulated for their profound scientific achievement.

For the free world, that achievement must be a warning. Under the stress of the present cold war, noncommunist nations have emphasized technical weapons superiority as a major deterrent to aggressors. Weapons superiority in 1957 means translating the complex science of nuclear power, supersonic flight, and guided missiles, into hardware for quantity production. Harnessing an idea in reliable producible apparatus requires engineering skill, manufacturing know-how, and dollars. The fact that the Russian satellite works means the Soviets can successfully solve this crucial problem, and are willing to spend the money for a workable solution.

While it can be argued that the I.G.Y. satellite is a peaceful research tool, the military implications of its successful firing are obvious. The problems of liquid fuel rocket operation, guidance, airframe construction, stage separation, performance in severe environment, and launching, are common to missiles with nuclear warheads and satellites with scientific instrumentation. The problem of making the parts, and assuring their reliability is similar for missiles and satellites. Production and test techniques learned from one device can be validly applied to the other. As it streaks through North American skies at 18,000 mph, the Soviet satellite testifies to Russian technical accomplishment.

The United States Government has confidently entered the I.G.Y. by reducing the defense budget, and proposing dangerous contractual restrictions on private industry engaged in military work, that are unrealistic in the face of required weapons complexity and performance. The armed services have expended considerable energy and words in rivalry over who can develop the best intermediate range ballistic missile, a device overshadowed by a successful Russian test firing of a missile with intercontinental range. Economy measures and elimination of duplication in weapons systems development are necessary. But the fact of Russian technical achievement is inescapable.

The Government must recognize that the technological demands of tomorrow's weapons require dollars, manpower and time today. Research, the building blocks of weapons progress, must be increased. Private industry must be encouraged to invest its talents in engineering development and its dollars in manufacturing facilities. Finally, technically trained men and women must be given incentive to use their abilities with dedication for government scientific work, and more opportunities must be made available through federal funds to educate scientists and engineers.

Congressmen and defense department officials who may be pleased with their "economical" and "realistic" policies probably will not see the Soviet satellite, and may forget that the delays in our own Vanguard satellite program are evidence of the fact that it is not cheap, quick, and simple to turn ideas into operating hardware. But every hour and a half, the man-made Russian moon will circle the earth in spite of the officials—a global warning in a year of wonder.

RGB

Editor's Note: Written several weeks before the launching of the second Soviet satellite, this editorial states the warning of I.G.Y. in conservative terms. The United States' Vanguard is totally obsolete in the perspective of the dog that lived in the Russian Satellite 1000 miles above the earth. The free world must face the inescapably urgent challenge that the present uncoordinated, inefficient, financially handicapped missiles development program of the United States is, in like manner, totally obsolete.

The United States must reestablish the confidence of the nations of the world in the worth of the American political and economic system. If it fails to do so, the nation faces the danger that individual freedom and initiative will be eclipsed in the hearts of men by the threatening shadows of new Red moons. *RGB*

Founded 1885

THE CORNELL engineer

NOVEMBER 1957 VOLUME 23 NO. 2

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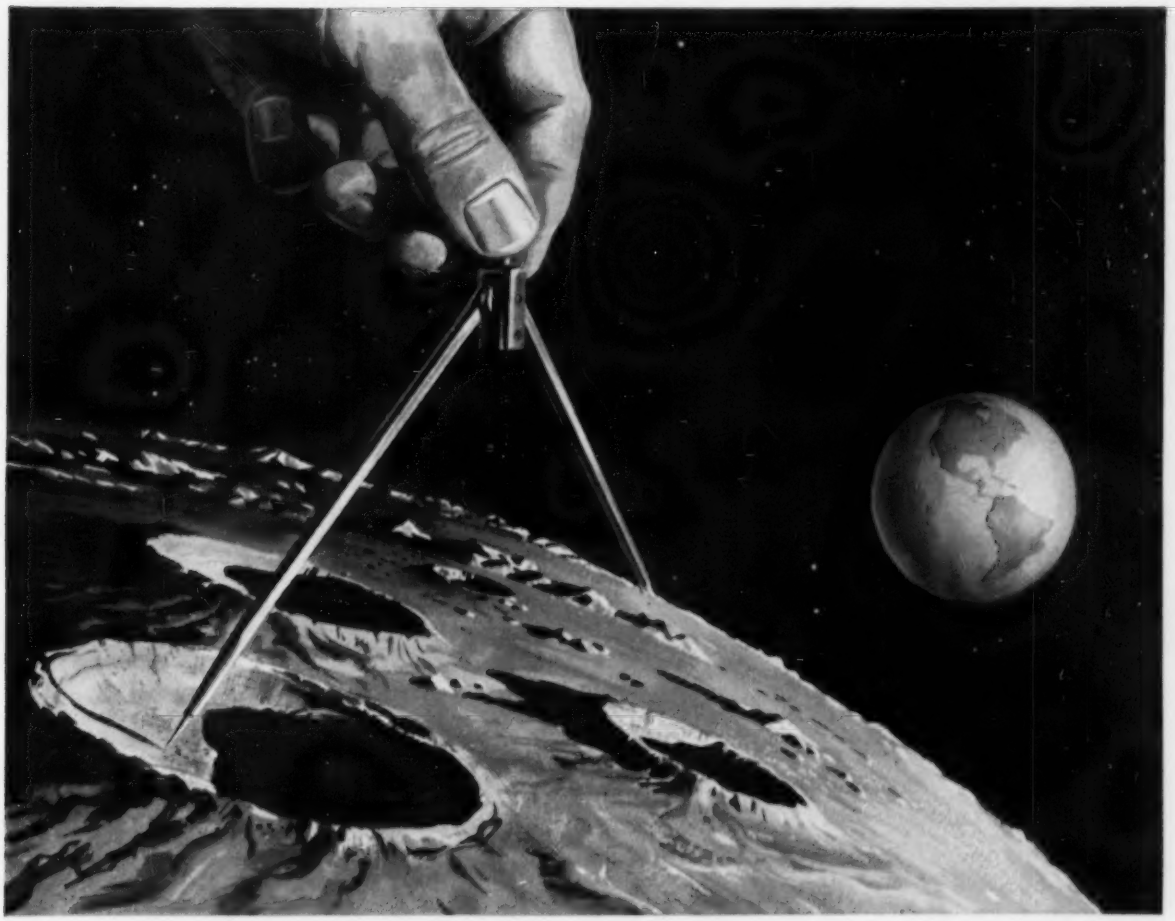
FIRST IN RAMJETS



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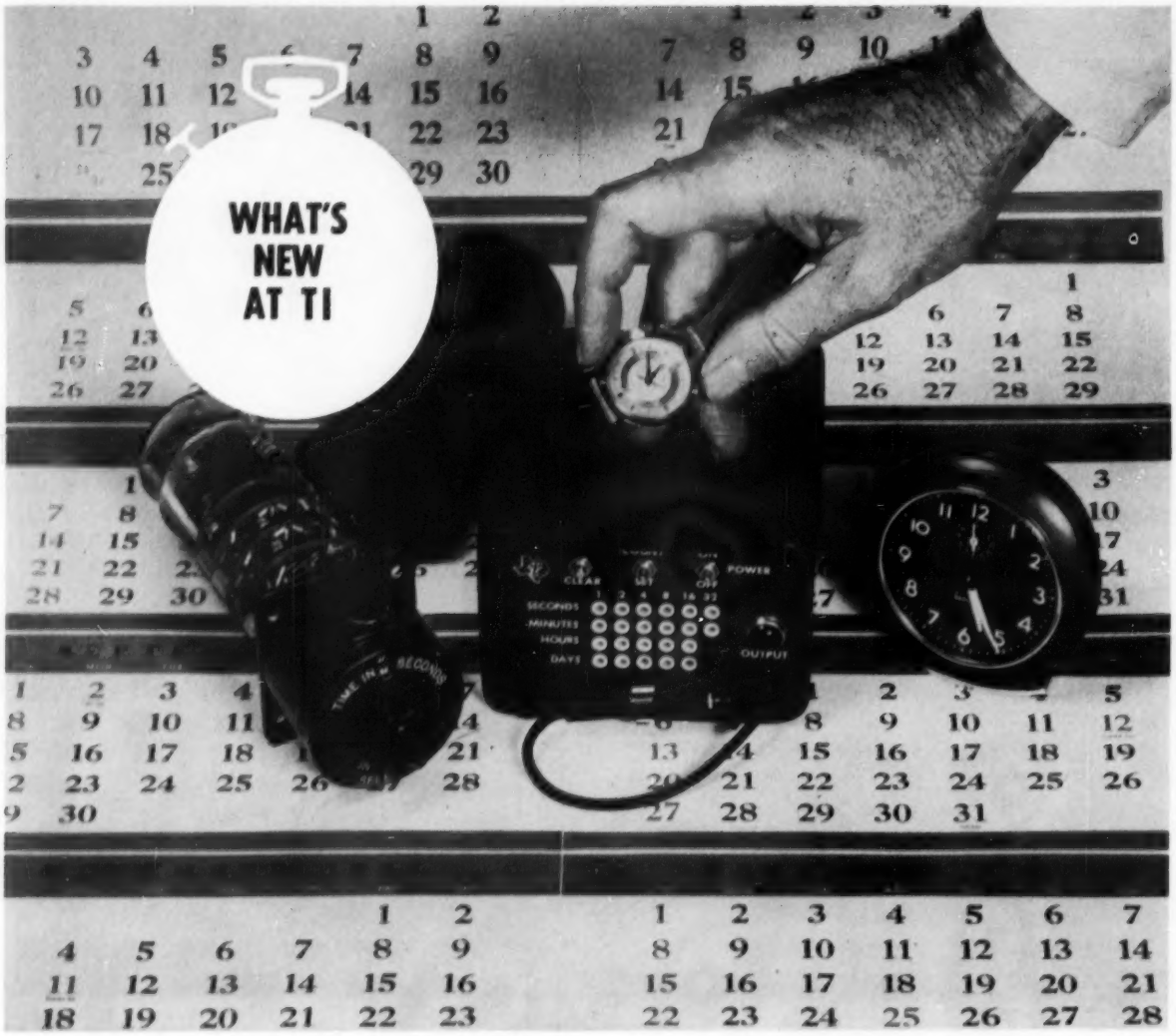

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How to make the most of your engineering career

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One of the many hurdles that can slow down your progress as an engineer is getting lost in the crowd. It can happen in smaller companies as well as in big ones.

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To be considered for the Program, applicants must have a bachelor's degree in science or engineering, and should have outstanding student records, show technical promise, and possess mature personal characteristics. They must be under 30 years of age on September 15 of the year admitted to the Program. They may apply for admission to the Program in anticipation of becoming employees of Raytheon.

YOU ARE INVITED TO ADDRESS YOUR INQUIRY to Dr. Ivan A. Getting, Vice President, Engineering and Research, outlining your technical background, academic record, school preference, and field of interest, prior to December 1, 1957.

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Facts on food colors

What about those headlines on food colors? And the stories that some certified food colors are toxic? Is there anything to the Food and Drug Administration's recent delisting of three previously acceptable colors?

Here are a few facts behind the headlines.

The practice of coloring food is centuries old. Though the early colors were of natural origin, they have been replaced in the coloring of many foods by superior synthetic colors — the certified "coal-tar" colors. The Food and Drug Administration has been certifying a number of these colors for use in food since the early 1900's.

You're probably aware of some of the foods commonly colored today: ice cream, soft drinks, baked goods, candies, processed cheese, gelatin desserts, orange skins, margarine, butter.

Why then have some food colors been "delisted" and why are others being considered for delisting?

The controversy centers on the meaning of a single word in the Federal Food, Drug and Cosmetic Act: "harmless."

The Food and Drug Administration's definition: incapable of producing harm in any quantity or under any circumstances.

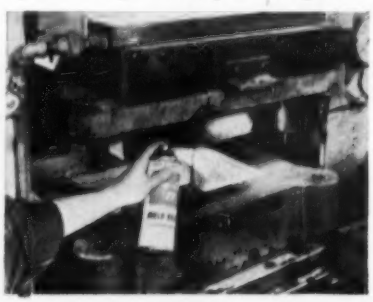
The food color industry's: incapable of producing harm under normal conditions of use.

It is the industry's view that FDA animal tests of certified colors have made use of quantities of color unrelated to — and far in excess of — quantities normally ingested by humans. A newspaper interview quoted the Commissioner of Food and Drugs as saying that he "conceded that three coal-tar dyes recently banned were harmless as used, but explained that their use was [a] technical violation of the law as now worded."

The absolute FDA standard seems to find support in the popular tendency to regard synthetics as inherently inferior to natural products. Yet, many fresh vegetables we eat every day contain small but tolerable quantities of naturally occurring poisons which, if judged as food colors are now being judged, would lead to the elimination of a large part of our vegetable diet.

What the food color industry asks is an amendment to the present law which would clearly grant power to the FDA to set quantitative limits on the use of colors in food. Such limits would safeguard public health, permit maintenance of our food color supply, and encourage research in the field.

Two articles — one supporting the industry's position, the other detailing manufacture and quality control of food colors — have been prepared by Allied's National Aniline Division, the leading food color producer. You can get them by checking the coupon at right.



Aerosol mold release

Remember the line that went, we could have some ham and eggs if we had some ham . . . and some eggs. Stretch your imagination a good deal, and it has some relevance in the business of molding.

Low-molecular weight polyethylene is a superior mold release.

There's hardly a more convenient way to dispense liquids than with an aerosol spray.

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SPECIAL REPORT ON I.G.Y.

In a world plagued with political strife and turmoil, it is truly encouraging to see scientists of the world unite in one common effort. The International Geophysical Year, now in progress, is the culmination of more than five years of planning by the sixty-one participating nations.

Planning the Program

The idea of holding an International Geophysical Year was first discussed in 1950 at a meeting of the Joint Commission on the Ionosphere. Scientific years of this nature had not been without precedent. International Polar Years were held in 1882-83 and 1932-33. In fact, the present program was originally intended as another Polar Year following the preceding one by twenty-five rather than fifty years.

As discussion of the project progressed, it became apparent that enthusiasm for the program was running high. Realizing the fact that modern equipment would make studies far more effective than ever before, scientists arrived at the bold plan of an International Geophysical Year to cover the entire globe, not only the polar region!

After further consideration, the eighteen month period beginning July 1, 1957 was selected as an ideal time for the project. This period was chosen largely because of the high solar activity anticipated. It will be eighteen months long to enable scientists to take two sets of data covering the same season of the year.

The date, having been chosen, the Comité Special de l'Année Geophysique Internationale (I.G.Y. coordinating organization) requested that each participating nation outline its own program. The result was a $500-million world research project. Of this amount, the United States is contributing $39-million for general research. An additional $100-million will be spent for the satellite program.

A large number of International Geophysical studies deal with phenomenon of the upper atmosphere. This group includes the satellite program, geomagnetism, cosmic rays, aurora and air-glow, ionospheric physics, and solar activity. Investigations are also being carried out in the fields of meteorology, oceanography, glaciology, gravity and seismology, and longitude and latitudes. A special research program is taking place in the Antarctic. This issue of THE CORNELL ENGINEER presents a detailed discussion of each of the major investigations being carried on during I.G.Y. with particular emphasis placed on the United States' program.

World Days

Studies in each of these fields are arranged separately by the individual participating nations. However, all work will be coordinated by the Comité Special de l'Année Geophysique Internationale. In order to achieve maximum research efficiency, the C.S.A.G.I. has organized a special means of international coordination.

During I.G.Y. there will be four types of specially designated world days or series of days on which special observing programs may be scheduled. One type of world day (known as a Regular World Day) includes the two consecutive days at new moon. Quarter phases of the moon or times of expected prominent meteor showers may also be designated Regular World Days. During these days there are increased observational activity in ionospheric physics, geomagnetism, and other fields.

The second type of world day, or Alert, is called by the National Bureau of Standards radio forecasting center at Fort Belvoir, Virginia. Such a period is designated at times of unusually active regions on the solar disk. Alerts often prove to be the forewarnings of Special World Intervals.

Special World Intervals are the third type of world days. They are called by the I.G.Y. World Warning Agency on about eight hours notice. The periods, starting at a predetermined time, are held when a strong geomagnetic disturbance is anticipated within twenty-four hours. The duration of a period depends upon the disturbance and brings intensified work in the ionospheric physics, geomagnetism, solar activity, cosmic ray, and aurora programs.

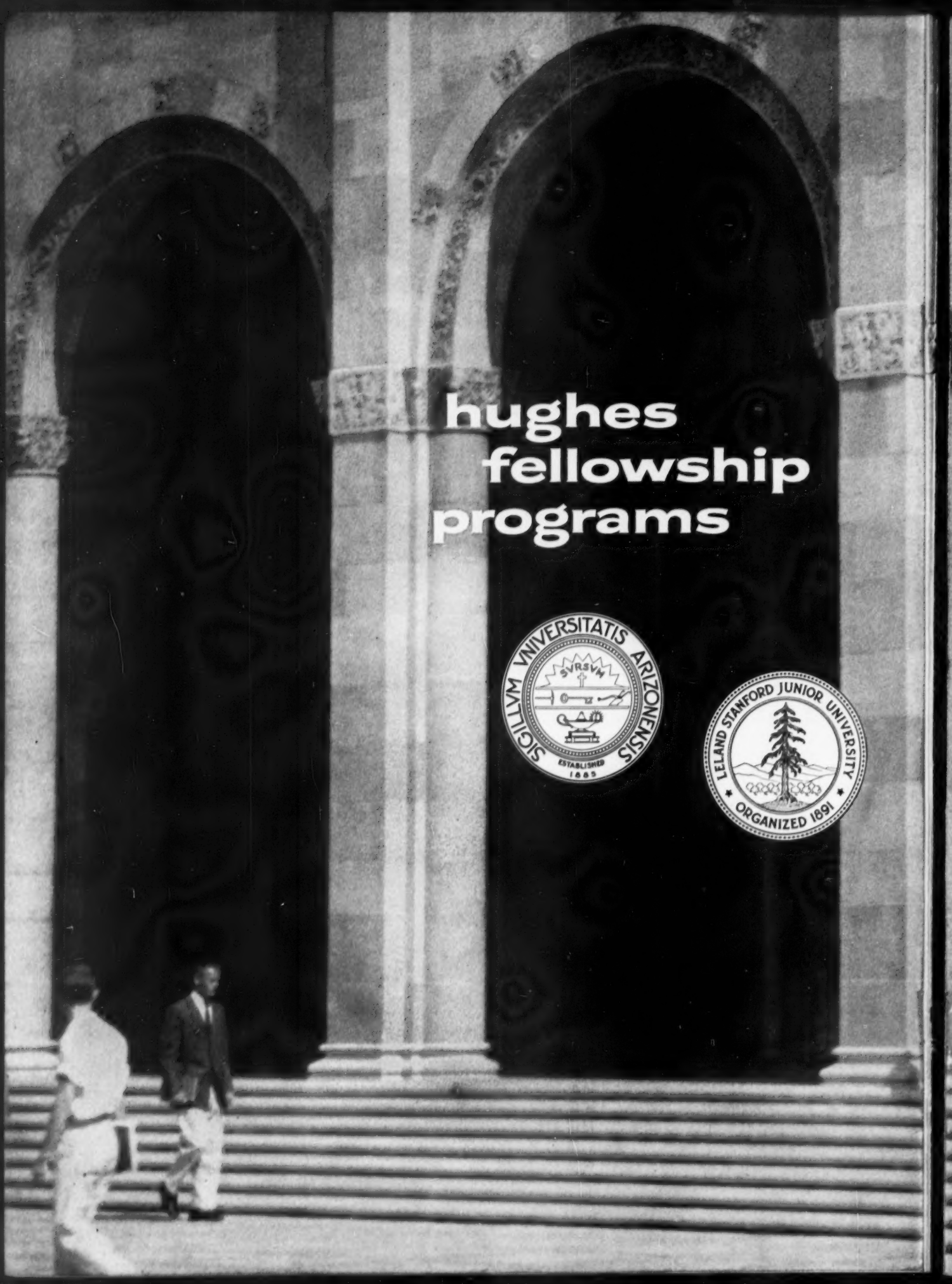
World Meteorological Intervals, the last kind of world day, are series of ten consecutive days each quarter including the solstice or equinox day and also three Regular World Days. Upper air soundings are increased with almost all rocket launchings being scheduled at these times.

At The Conclusion

Although the I.G.Y. will officially terminate on December 31, 1958, some programs will continue several months after that date. However, the important job of processing information gathered during I.G.Y. will continue many years after that time. In fact, it is believed that it may require a generation or more to reduce and interpret the mass of information gathered.

And the value of all of this? What will be the results of the millions of dollars and billions of man-hours expended during I.G.Y.? This question is difficult to answer. When all the information gathered is studied, it will undoubtedly result in improved communications, more accurate weather forecasting, and a greater mastery of the polar regions. Of course, the implications that I.G.Y. will have in other scientific areas is not readily estimated. But whatever the scientific results, it is certain that International Geophysical Year will provide an excellent example of international cooperation.

A.S.R.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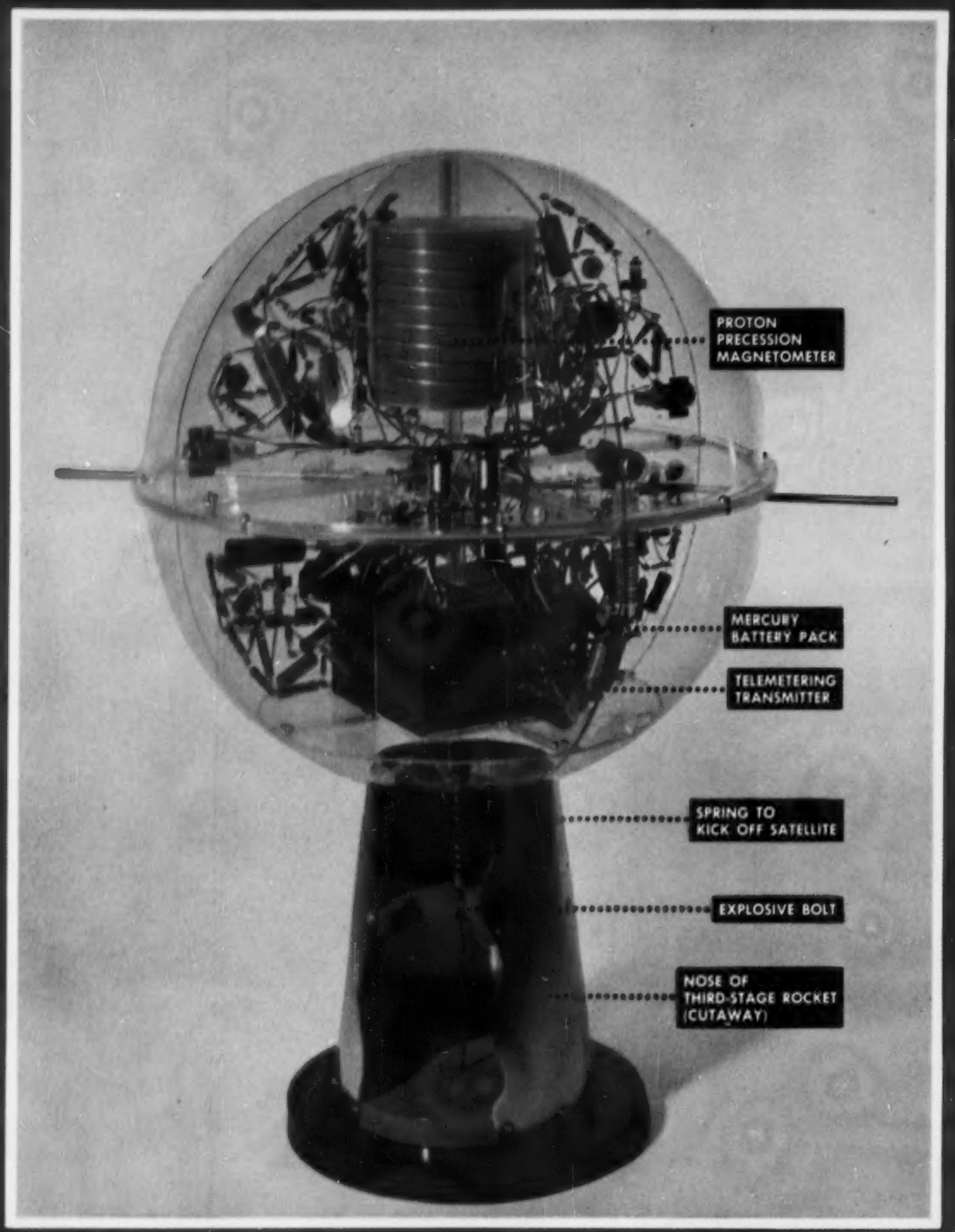


Courtesy Popular Science Monthly

Special Report on I.G.Y. . . . . .

AROUND THE WORLD IN NINETY MINUTES

by

John A. Bewick, EP '60

A gold plated sphere, 20 inches in diameter, will become the United States' first artificial satellite sometime early next year. This exciting news was first announced by President Eisenhower on July 29, 1955. It came as the result of a study conducted the previous year by U.S. National Committee for the International Geophysical Year. The Naval Research Laboratory was given the responsibility for developing Project Vanguard—the satellite and its launching vehicle. The Martin Company was named prime contractor for the rocket because of its pioneer work in this field.

What is the value of launching a satellite? For the first time, scientists will be able to study the properties of the upper atmosphere for an extended length of time. Whereas previous high altitude research rockets were aloft only a matter of minutes, the satellite, once launched in its orbit, is expected to remain aloft for weeks. It will transmit previously unavailable data back to eagerly waiting scientists.

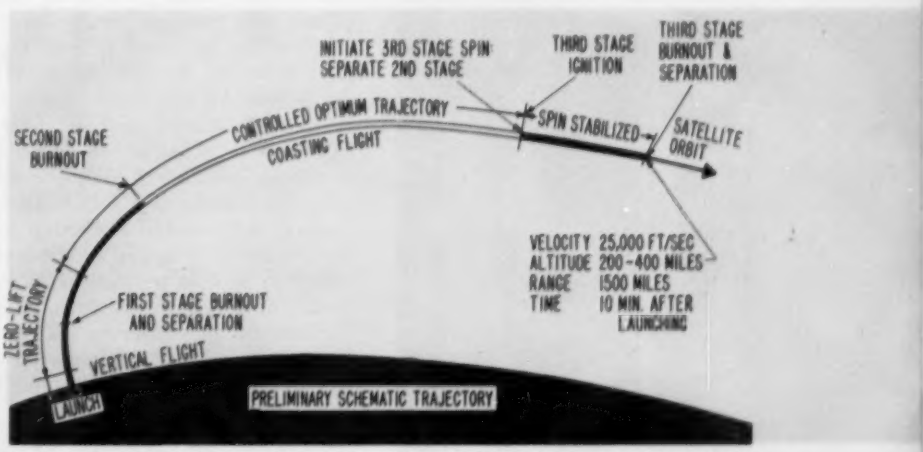
Project Vanguard will set many new records. It will be the first time we can say that what goes up, won't necessarily come down. The three stage launching vehicle will elevate the satellite to an altitude of 300 miles or better, with a velocity of 18,000 miles per hour, which is twice the speed of any previous rocket. The three stage rocket embodies many new concepts in rocketry, most noticeable of which is its lack of fins.

The main purpose of launching the Vanguard is to place the small sphere into an orbit which circles the earth and enables scientists to collect valuable data contained in the atmosphere. The satellite, which is just greater than twice the size of a basketball, will weigh 21½ pounds. Approximately half the weight of the satellite is for the instruments it carries. Its velocity will exceed that of the moon, the speed of sound, or the fastest bullet.

The Artificial Satellite

To an onlooker, the satellite is a silverish sphere containing four circular windows and four whip-like antennae. Inside are four bulky looking struts which support the sphere's skin and instruments. In the center there is a cylinder 5½ inches in diameter and 7½ inches high, which contains most of the compact instruments in this cylindrical section. A battery, which lasts 350 hours, is in the bottom layer of the cylinder with a miniature transmitter. The inside will be sightly pressurized to allow gauges to measure pressure drops caused by meteor impacts.

As protection for its instruments, the satellite has a tough, heat resistant skin which is only .033 inches thick. Magnesium, a light but strong metal, was chosen as the



The trajectory of the Vanguard research vehicle, depicting burnout positions of the three stages of the vehicle in its flight to place a satellite in its orbit above the earth.

base of the spherical shell. To enable it to withstand high temperatures, it is coated inside and out with layers of gold .00005 inches thick. On the exterior, the surface is further covered with layers of chromium, silicon monoxide, aluminum, and finally another layer of silicon monoxide.

Scientists hope to learn about the following subjects from the satellite:

1. The density of the upper atmosphere.
2. The composition of the earth's crust, including variations in mass.
3. Deviations from the calculated orbit which will enable precise geodetic determination of latitude and longitude.
4. The earth's heat balance determined by bolometers and temperature readings inside and outside the skin.
5. The effect of meteor impacts and erosion on the satellite's skin.
6. Pressure inside satellite to determine penetration by meteor particles.
7. The effect of ultraviolet radiation.
8. Cosmic ray intensity.

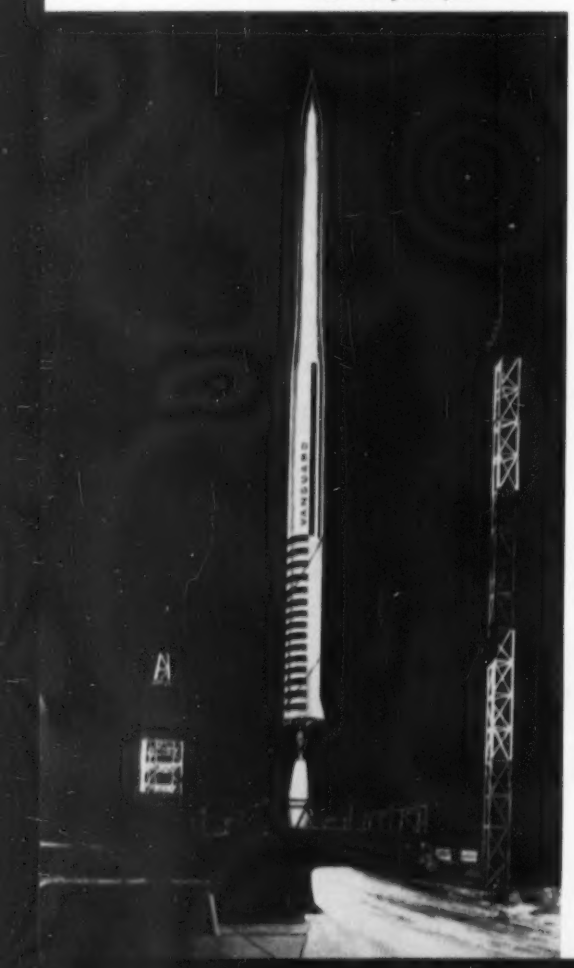
The above information will be coded on a plastic telemetering card which combines up to 48 signals from the various instruments. This signal is then transmitted to stations on earth.

I.G.Y. was planned to catch the peak of the eleven year sunspot cycle. With the aid of the satellite and high altitude rockets, scientists hope to discover the cause of electric storms which fluctuate with sunspot activity and which interfere with radio transmission. Studies have shown thus far that X-rays and not Lyman Alpha particles are responsible for radio fadeout. The satellite should give more complete data to verify these observations with recordings of ultraviolet radiation. Also, while the batteries hold out, the satellite will send back extensive data about cosmic rays. Since most cosmic rays are absorbed in the ionosphere, this will be the first time that their effects will be measured in significant quantities. Scientists hope to gain more accurate information about the source of these high energy particles.

One aspect of this project, which is of special interest to the average person, is the weather study, which should enable meteorologists to predict large weather patterns. The satellite will measure the terrestrial energy balance of the earth with two bolometers which measure the heat absorbed and given off by our planet. The principal energy input received by the earth is from the sun's radiation. Some of this is diffusely reflected by clouds while the remainder is converted to heat. This heat is ultimately re-radiated as diffuse radiation in the infra-red spectrum. Comparison of bolometer readings will enable prediction of heat balance. Weather forecasters will then be able to discover large masses of clouds, by comparing the fluctuations in difference of the bolometer readings, and hence they will be able to predict an overall weather pattern.

Radio operators who are occasionally bothered by poor transmission will get an insight into the cause of the disturbances from a study of the earth's magnetic field. There are two components of this field; one is more or less permanent, associated with the earth itself, while the other varies greatly. Probably this second field is created by the motion of electrical charges in upper levels of the atmosphere. These disturbances extend to distances several times the radius of the earth. From the results of the satellite, scientists hope to verify or disprove many theories in this field.

The 72-foot, 11-ton rocket vehicle begins its trip into space.



The Vanguard satellite launching vehicle rises from its firing stand in a Martin Aircraft Co. portrayal.

Observation of the satellite's orbit with its perturbation, will enable geodetic scientists to make more accurate studies of the earth's oblateness as well as study the mass distribution of the earth. Comparison of averaged calculations of the satellite's orbit with readings from radio signals will disclose the amount of ionospheric refraction; thus providing information about the electrical charge characteristics of the ionosphere.

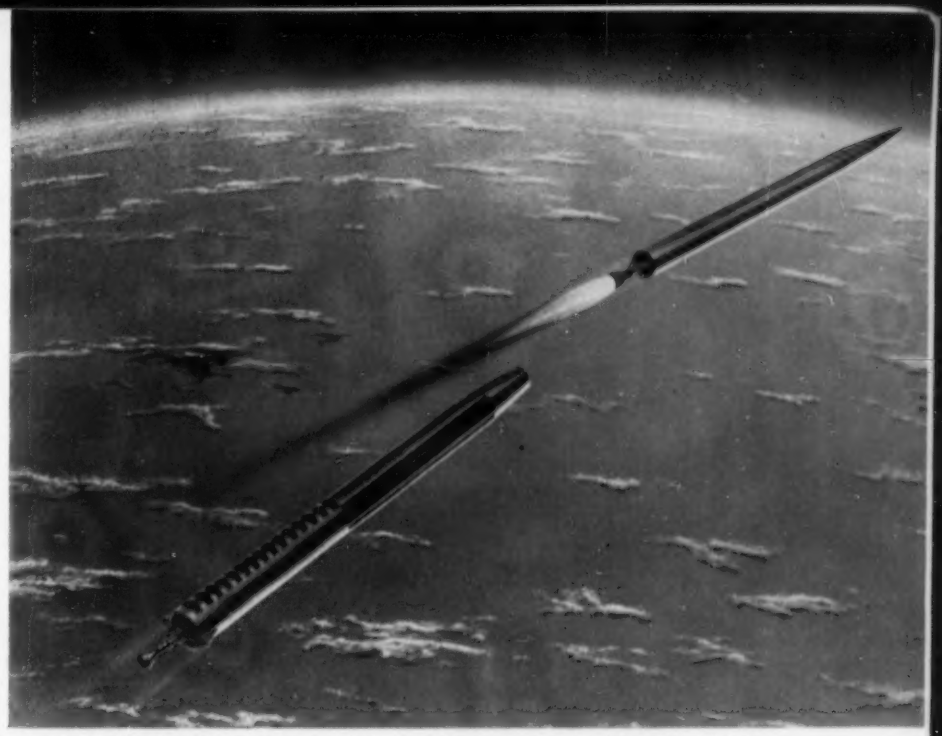
Observation of the Satellite

An important phase of the satellite project will be the observation and calculation of the orbit with its variations. This will be done in two ways by radio signals from the satellite through the Minitrack System and through visual observation *both* by a Schmidt camera and observer teams with small telescopes.

The Minitrack System involves the receiving of radio signals from the satellite transmitter with two

pairs of antennae. The antennae are orthogonal, and the distance between them is known. By measuring the phase difference between the sets of antennas the angular position of the satellite can be computed. Then, knowing the distance between antennae and the phase relationship the exact position may be calculated by establishing two directional cosines (one side, the hypothenuse, of a right triangle is the distance between the antennae, while another side, a leg, is given by the phase difference). The satellite transformer will probably operate on 20-50 milliwatts power at 108 megacycles. It will have an average accuracy of about 3 minutes of an arc with maximum accuracy of 20 seconds of an arc at nighttime with small zenith angle. Minitrack stations are being set up in Chile, Ecuador, Panama, Cuba, Australia, and in Washington, Savannah, Jacksonville, and San Diego. These stations will receive synchronized time signals from WWV. Early information on the first revolutions will be fed to computers which will calculate the orbit. This information will then be published so that visual observers will be able to pinpoint the satellite with their telescopes.

The Schmidt Camera costing $80,000 has been developed to accurately observe and then record that satellite in flight. The improved Schmidt Camera uses an F-1 Schmidt-type system with 20 inches aperture, with mirror aperture of 30 inches. It is estimated that it can track a 15 inch sphere at 1000 miles altitude which corresponds to a stellar magnitude of 10 to 11. The satellite requires stellar magnitude from 6 to 9 corresponding to the minimum perigee and maximum apogee. It will be accurate to within 2 seconds of the arc. The camera will have a continuous film strip calibrated with crystal clocks. The crystal clocks are synchonized with the WWV signal which is accurate to a millisecond. In order for the Schmidt camera to locate the satellite, its path must be known to 3 degrees. Proposed observation stations are being established along the 75th meridian at White Sands, New Mexico; Cocoa Beach, Florida; in Venezuela; Chile; Argentina; South Africa; Australia and other possible locations around the world for extensive latitude and longitude coverage.



Once the fuel in the first stage is expended, the entire stage drops off into the Atlantic Ocean to reduce weight during the rest of the flight.

The U.S. National Committee has organized almost 100 volunteer teams in *Operation Moonwatch* to visually observe the satellite's orbit. The teams are strategically located to insure the fullest possible coverage. They will send their reports to the communications center at Fort Meade, Maryland, where the information will be compiled and orbits calculated. Each team will use telescopes of one power and a long pole erected vertically with a crossbar at top. As the satellite moves across the sky the observers will attempt to locate it knowing its approximate orbit and then determine the exact time at which it is obliterated by the center of the crossbar. They will then report the time this occurred and the angle of observation to the center. The center will then compute the position of the satellite from many such stations and determine the satellite's orbit more precisely.

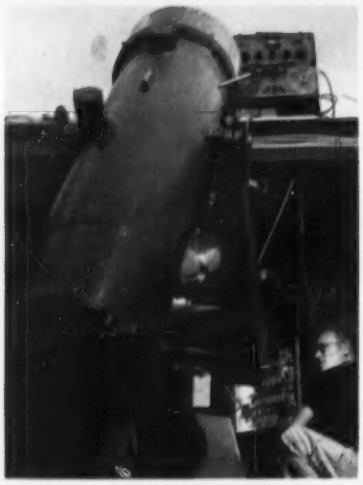
The stations will show some of the fluctuations from the calculated orbit and hence give scientists an accurate picture of the satellite's motion. Even after the transmitter in the satellite goes dead, much information will be gained by the observations, especially when the satellite eventually falls toward the earth and is burned up.

The four or five observers in each of the teams will sacrifice many sleeping hours since the best times for observation are at dusk after the sun has set and at twilight before the sun has risen in the sky. Teams will probably be able to get two or perhaps three observations at each of these times. Despite the odd hours, enthusiasm is running high among the volunteers. More nonscientific personnel will be used in this project than at any other time in the past, and results are expected to be highly accurate. Already observers have been practicing by spotting a light trailed from a small plane.

The Vanguard Launching Vehicle

The most difficult task of Project Vanguard has been the designing of a rocket which is capable of launching the satellite into the proposed orbit. Once the Naval Research Laboratory released plans for the satellite, Martin Engineers went to work on the problem of launching it.

Before designing the rocket, they had to calculate the initial conditions for establishing a circular orbit 300 miles above the earth. Then they had to decide on the maximum tolerance of error. This orbit was chosen as most practical for collecting data, tracing the satel-



US Navy's calibration camera, designed to orient the satellite tracking station with respect to the stars. The tape recorder in the background is used to record data obtained while calibrating the station.

lite's path, and launching the satellite in the short time allowed for design and construction. Relatively simple calculations using Newton's Laws of Motion show that the satellite must have a tangential velocity of 18,000 m.p.h. to remain in its proposed orbit. As an idea of the problem involved, this is twice the speed of any previous rocket. In addition, the satellite must attain this speed while exactly tangent to the earth's surface.

With present rocket techniques, engineers hope to launch the satellite in an elliptical orbit with a perigee (minimum altitude) of 200 miles and an apogee (maximum altitude) of 1500 miles. These limits were chosen because an apogee of greater than 1500 miles would make tracking, both by radio and optical methods, virtually impossible; and a perigee of less than 200 miles would cause the satellite to lose velocity in the dense region of our atmosphere where it would eventually burn up. This elliptical orbit allows maximum errors of 350 m.p.h. in velocity and 2¼ degrees in altitude while attempting to establish the ideal, circular orbit.

The adjoining illustrations show the three stage, finless rocket designed to inject the satellite into its orbit. The launching vehicle is longer and sleeker than any of its predecessors. Its engines are, of course, more powerful. The absence of fins makes its design unique.

The schematic drawing of the initial trajectory depicts the responsibility of each stage of the 72-foot rocket in launching the satellite.

The first stage will propel the rocket through the most dense part of the atmosphere to an altitude of 36 miles. At this point the Vanguard will have a velocity of 5,500 feet per second and an inclination of about 45 degrees to the vertical. The first stage is then separated from the remainder of the launching vehicle and falls to the earth 275 miles from the launching site.

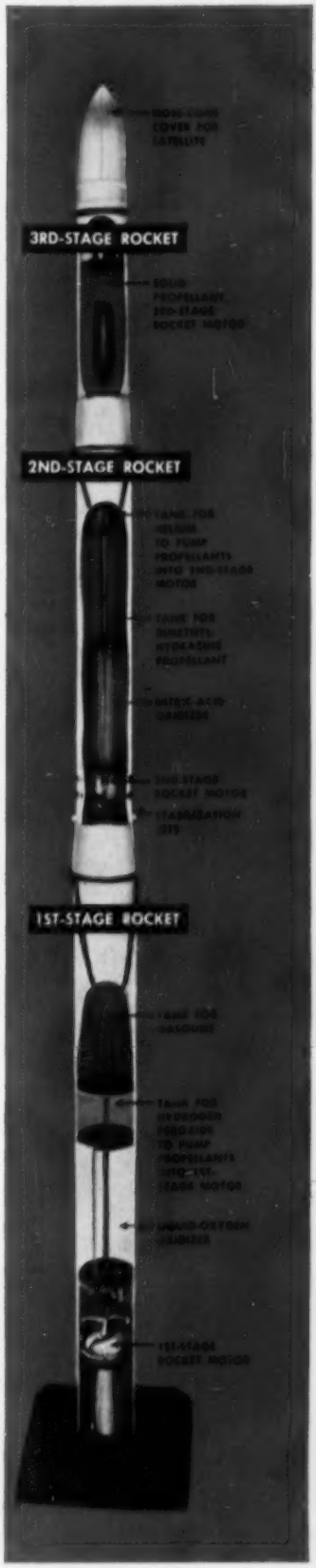
Immediately after first stage burnout and separation, the second stage is ignited and carries the rocket to an altitude of 140 miles. The two stages will then have a velocity of 13,400 feet per second, which enables them to coast to the desired altitude of 300 miles. The nose cone which protects the satellite in the dense part of the atmosphere will be jettisoned during the powered flight of the second stage.

As the desired altitude is reached, the third stage is spun on its longitudinal axis by the second stage, which acts as turntable operated by jets. This gives the only stability control of this stage. The principle of control is similar to that of a revolving bullet. When the third stage becomes tangent to the earth's surface, it is fired by the second stage controls and propels the satellite to its final velocity of 18,000 m.p.h. The satellite is then separated by a spring mechanism and both the satellite and third stage rocket follow orbits around the earth. This is the first time we will have overcome the effects of gravity for any length of time.

Since the third stage is lighter per unit volume than the satellite, it will have more air drag per pound. Hence, since it weighs more than the satellite, it will fall towards the earth and burn up like a meteorite. This will eventually happen to the satellite even though air resistance is caused by molecules which are more than a mile apart from each other.

The satellite will be launched at an angle of 35 degrees to the equator to give the most benefit possible in launching, of the earth's spin and still permit extensive observation over large land areas. To give you an idea of how much this amounts to; at the Equator, the earth's rotational velocity would contribute 1515 feet per second to the velocity of the satellite if it is launched due east. If launched due east at Cape Canaveral, Florida the velocity contribution is 1340 feet per second, and if launched 35 degrees to the Equator (as proposed) the earth's velocity contribution is 1170 feet per second. The orbit will extend from 35 degrees latitude north to 35 degrees latitude south of the Equator. This covers a large part of the United States and the Latin American countries.

The first stage must lift the entire Vanguard, weighing 22,600 pounds, to a height of 36 miles with a final velocity of 5,500 feet per second. To do this, the first stage has a G.E. built rocket engine with an initial thrust of 27,000 pounds. As shown in the cutaway view of the Vanguard launching vehicle, a hydro-



Components of three-stage rockets that will send the baby moons into their orbits are shown in this model.

Design of the model was based on official information that has been released on the actual Vanguard missile.

Triggering mechanism in nose of third-stage rocket is tripped by young lady below, showing how the man-made baby moons may be injected into their orbits. The rocket model was built by Dr. I. M. Levitt, director of the Fels Planetarium, Philadelphia.

Courtesy Popular Science Monthly

gen peroxide tank rests above the engine. This is used to drive the turbines which feed fuel into the engine. The helium in the next section is used to pressurize the fuel cells. In the forward most section are the fuel cells containing liquid oxygen and a form of kerosene. This stage is 44 feet long and has a mean diameter of 45 inches, the largest and most powerful of the stages.

Control of stability and direction in the first stage is accomplished by housing the rocket engines in gimbaled mounts. This allows two plane control of thrust to correct for pitch and yaw. Roll control is obtained by using small jet reactors fed by the turbine pump exhaust. The thrust cylinder extends aft of the rocket structure and is controlled by hydraulic actuators. These actuators and the roll jets are controlled by a "nerve center" in the second stage which has a built-in flight plan and which can adjust the controls so that the rocket follows the predetermined path.

Saving weight is crucial for success in launching the satellite since each extra pound in the first stage causes a loss in velocity of 1 foot per second, in the second stage—8 feet per second, and in the third stage—80 feet per second. The use of a gimbaled mounted engine in the first stage gives enough stability control to eliminate the need for fins. Fins are ineffective in the upper, thin atmosphere where there is a lack of air. The structural skin is made leak proof by the use of special rivets and gaskets. It is used as the walls of fuel cells in many places. This eliminates the need for double containers. A considerable amount of weight is saved by these methods.

The second stage is 31 feet long with a mean diameter of 32 inches. It is used to propel the rocket from 36 to 140 miles and increases its velocity of 13,400 feet per second. It burns a fuel consisting of fuming nitric acid and unsymmetrical dimethyl hydrazine in its rocket engine built by the Aerojet General Corp. Similar to the first stage, its thrust cylinder extends aft of the rocket structure on gimbaled mounts. The stability controls are also similar to the first stage.

The electronic gear, housed in this stage, controls the path of the rocket after its initial firing. Included in the electronic controls is a three dimensional reference system consisting of three integrating rate gyroscopes. The guidance system contains a pitch programmer which actuates controls so that the rocket follows the desired flight trajectory. It uses the reference system above as a guide. There is also an integrating linear accelerometer which determines the velocity of the rocket and makes in flight corrections to the satellite injection time.

The third stage accelerates the satellite to its final velocity of 18,000 m.p.h. It contains a solid propellant rocket. A dual design program is being undertaken by the Allegheny Ballistics Laboratory and the Grand Central Rocket Company. The only controls over this stage are the time that it is fired and the stability which it gains from being spun before firing on the second stage.

When the satellite is ultimately placed in an orbit, scientists will begin receiving the rewards for this costly endeavor by the amassing of facts which the satellite will deliver. Launching of a satellite is a portent of future accomplishments in the rocket field which may eventually lead to space travel. Through studies of cosmic rays, sunspot activity, and the other programs of Project Vanguard, we will greatly increase our understanding of the universe. Hence, I.G.Y. offers the brightest prospect ever known for scientific achievement.

Interior view of a satellite tracking van. The equipment shown here will record the satellite's position, and this data will be used to predict the satellite's orbit.

Special Report on I.G.Y. . . . . .

MAPPING THE MAGNETIC FIELD

by

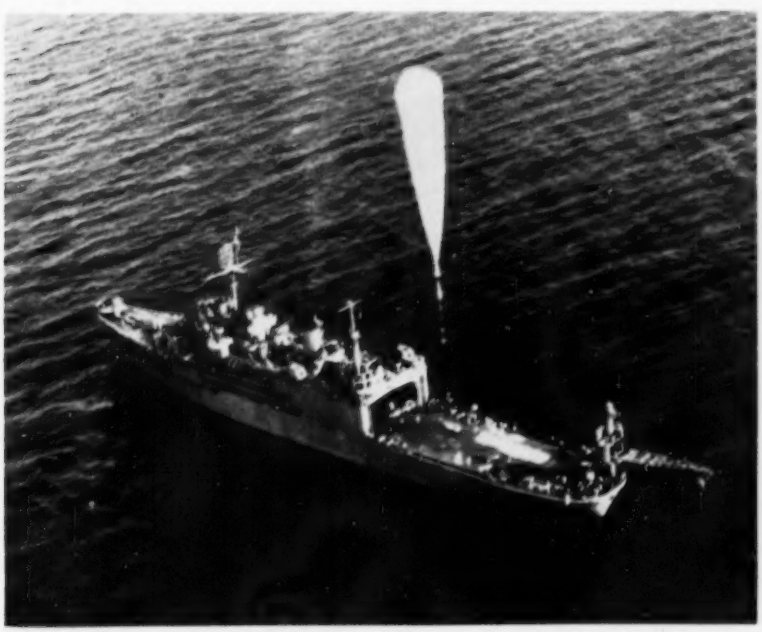
Ben E. Lynch, EP '60

Among the persons most pleased when the International Geophysical Year began with violent sunspot activity were the scientists studying geomagnetism. For the sunspots were accompanied by variations in the earth's magnetic field, and these fluctuations are one of the major areas of study during the I.G.Y. program.

Strange Electrical Nature

The fluctuations, which are also associated with auroral displays and interruptions in radio transmission, have frequencies ranging from less than one cycle per second to fifty cycles per second. They are thought to be the result of solar radiation disturbing the upper atmosphere. Strangely enough, they act as if they are caused by tremendous electric currents, measured in hundreds of thousands of amperes, flowing in the upper atmosphere. Finding evidence that will demonstrate the existence of the great currents is a primary problem of the geomagnetism program.

There seem to be three currents, one in each magnetic polar region, and one around the equator. Although the currents are very large, a single magnetic observatory cannot learn a great deal about the overhead currents. Thus, it is necessary to have a network of stations. Also, the spacing of the stations in the network should be about the same as the height of the currents, suspected to be 65-125 miles. The United States has therefore built additional observatories to fill in networks in North America, Antarctica, and the Pacific Islands. There is one network for each of the three postulated currents.



First launching of a "Skyhook" flight, carrying neutron counters from New York University and the University of Minnesota through stratospheric temperatures down to −80° C. and up to an altitude of 90,000 feet.

Observation Networks

In Alaska, new stations at Anchorage, Kotzebue, Fort Yukon, Northway, Barter Island, Healy, and Big Delta will aid those already present at Sitka, College, and Point Barrow. These stations spread across the zone of maximum auroral frequency and the zone of the overhead currents. There will even be recording instruments maintained on an ice floe.

Widely scattered observatories will be making measurements in the equatorial zone. In the Western Pacific, the islands of Koror and Guam house complete stations. The Central Pacific region will be covered from the islands of Palmyra and Jarvis. In South America, a five-station net will be established with the help of the Department of Terrestrial Magnetism of the Carnegie Institute.

Several nations will establish

(Continued on Page 27)

Special Report on I.G.Y. . . . . .

COSMIC RAY RESEARCH

by

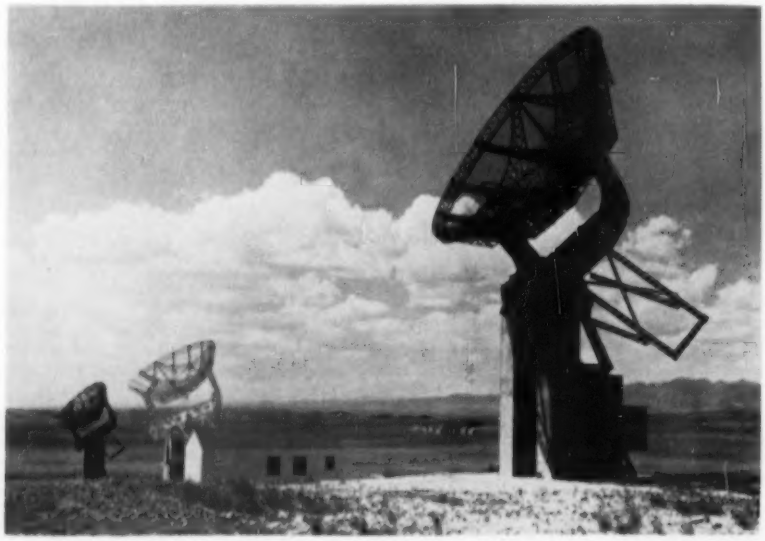
Peter H. Jedel, EE '61

As part of the International Geophysical Year, an intense study of the mysterious cosmic rays is being undertaken for the first time. Many aspects of the rays will be investigated using some old methods as well as many new ones. Cosmic rays, as they are understood today, are streams of electrically charged particles. Most of the particles are protons, but there are some alpha particles and a few heavier nuclei. There is a wide range of energy output ranging from 5×10^8 e.v. to a possible value of 10^{19} e.v. There has been a connection shown between solar phenomena and cosmic ray intensity, but just what it is remains undecided. The plan of the U.S. program is to throw as much light as possible on fundamental problems.

Flight Tests

It is a well known fact that cosmic ray radiation varies with time, temperature and magnetic disturbances. Flights will be sent up at various latitudes at coordinated times attempting in this way to determine some measure of the variation of cosmic radiation. Plans are also being formulated to send aloft flights during magnetically clear and magnetically disturbed days. The flights will be made from several stations at different latitudes and will carry aloft Cerenkor counters, proportional counters, pulsed ionization chambers and Geiger counters, as well as photographic emulsions.

There is some doubt as to the geographic distribution of cosmic radiation. Therefore, in order to evaluate the latitude effect and to decide whether cosmic radiation is symmetrical about the equator, it is planned to make a series of flights by aircraft and by balloon containing neutron counters, ionization meters and neutron intensity monitors.



Three parabolic antennas for the reception of cosmic radio noise of frequencies 50-200 megacycles. These signals come from our own sun and from outer stellar sources, the so-called "radio stars."

Ground Observation

To study the fluctuation in cosmic radiation and to correlate these with solar disturbances and with geophysical phenomena, it will be necessary to operate long time recording equipment at various stations. Cosmic ray telescopes, air shower detectors, ionization chambers and neutron monitors will all be employed at these stations.

Fluctuations of cosmic rays are somehow correlated with some types of solar disturbances. There are two types of solar disturbances —one is a slow change usually resulting from a change in the magnetic cutoff at any given place from a fluctuation in field. In this case the primary radiation is unaffected.

The second type of variation is caused by an abrupt increase in intensity and is somehow related to solar flares. The intensity of these short increases is greater percentage-wise and is larger for locally produced neutrons than for the total ionizing radiation.

Balloon and Sea Studies

The distribution of the heavy primary cosmic rays is also under study. Photographic material will be exposed at high altitudes, carried aloft by balloons. The three methods used for measurement of charge of the heavy primaries are delta ray counting, gap counting and grain counting. The flights will be at 95 to 100 thousand feet in the equatorial area to obtain information on the energy spectrum of the primary radiation.

Not all of the recording apparatus will be land based. There will be two neutron pile structures with recording apparatus set up on ships in order to record the effect of changes in latitude upon the cosmic radiation. This will also provide data regarding time variations and the effects of solar disturbances upon the intensity. The time variation of neutron components of cosmic rays will be measured. One monitor will be set up at College, Alaska and there is a possibility another will be established at Thule. Emulsion blocks of large size and suitable shape will be used in high altitude balloons to determine the isotopic constituents of cosmic rays. The northern latitude and the geomagnetic equator will be carefully studied.

Civilian technicians fill cosmic research balloon with helium during the recent Greenland Cosmic Ray Expedition.

High altitude balloons and instruments rise into atmosphere near Greenland after being launched from shipboard.

A study is planned to determine the zenith angle of the intensity of high energy mu-mesons. The present theory seems to suggest that there is competition between decay and absorption of the parent pi-mesons high in the atmosphere. Tests will be conducted to determine the composition of the cosmic rays and to see the mu-meson component of the cosmic radiation. Cosmic ray counters will be used to determine the fluctuations of the ray output. The various amounts of energy in a shower will also be measured. Connections between solar flares and other solar activity with cosmic radiation will be considered.

Scientists throughout the world are anxiously awaiting the results of these experiments. They feel that not only will our knowledge of cosmic rays be increased, but new fields of knowledge will be opened.

MAGNETIC FIELDS

(Continued from Page 25)

magnetic observatories in the Antarctic region. These stations will be especially valuable in studying the connection between Arctic and Antarctic magnetic disturbances. Scientists will be able to learn if the northern and southern auroras light up simultaneously, as they should according to theory.

Long Range Effects

In addition to the relatively rapid fluctuations that accompany sunspot activity, there are slow changes in the earth's magnetic field measured in months and even years. A compass needle does not point in the same direction from year to year, although the change in any single year is small. However, taken over a period of many years the effect can be great, as illustrated by the fact that at one place in England in a period of 232 years the compass "north" changed thirty-five degrees.

Of course, trying to detect this slow change in the earth's magnetic field makes very careful measurements of the field necessary. Cosmic rays give scientists a way of measurement. Since they are charged, cosmic rays are affected by the magnetic field. Their intensity is much greater at ground level near the magnetic poles, where lines of force are vertical, than at the magnetic equator where lines of force are horizontal. Stations all over the world will take data on cosmic ray intensity, and these readings should indicate the size and shape of the field. The earth satellites may carry instruments to check cosmic ray intensity, and thus show the high-altitude magnetic field.

During this special year, scientists will be exploring the earth's magnetic field with the most powerful tools ever at their disposal. With the help of world-wide organization they will correlate data in a manner heretofore impossible. The science of geomagnetism, that was inaugurated several centuries ago to aid surveying and navigation, will this year receive the greatest influx of information in its history.

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MARS OUTSTANDING DESIGN SERIES—featured in the current advertising of J. S. Staedtler, Inc.—has attracted widespread attention among the users of fine drafting pencils. It has fulfilled our expectation that the men who appreciate the finest working tools are those with a lively creative interest in new designs, new projects, new ideas.

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The subject can be almost anything—aviation, space travel, autos, trains, buildings, engineering structures, household items, tools, machines, business equipment, etc. It should be a project that appeals to design-minded readers, be of broad interest, and be attractively presented. Do not submit a design that has been executed. As a matter of fact, the project does not need to have been planned for actual execution. It should, however, be something that is either feasible at present or a logical extension of current trends. It cannot be unrealistic or involve purely hypothetical alterations of natural laws.

There is no deadline for entries but the sooner you send yours in, the greater the probability of its use as one of the subjects in the 1958 Mars Outstanding Design Series.

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Send your entry to:

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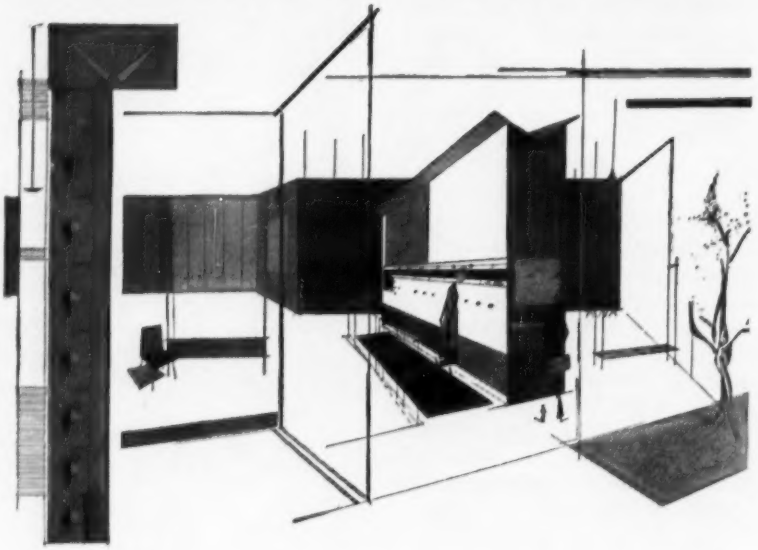
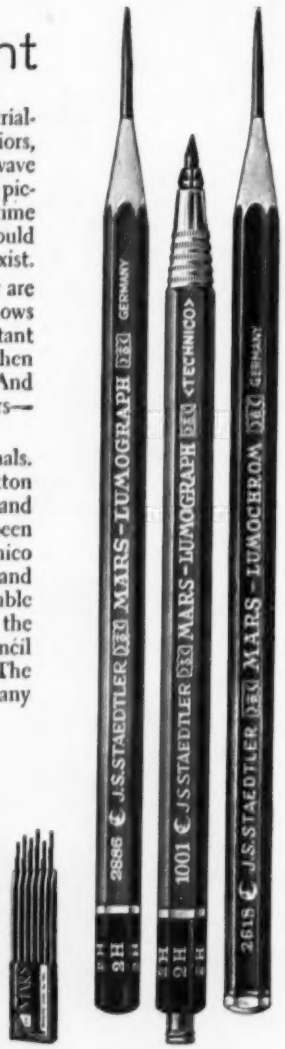


chef-less restaurant

This concept of Sue Vanderbilt, Pratt industrial-design graduate now designing GM auto interiors, would assemble a whole meal and cook it by microwave in a few seconds. Customer would merely check picture menu, insert money, push buttons. By the time he reached the far end of the counter the meal would be waiting, piping hot. All components already exist.

Many designs that will make news tomorrow are still in the "bright idea" stage today. No one knows which will flower into reality. But it will be important in the future, as it is now, to use the best of tools when pencil and paper translate a dream into a project. And then, as now, there will be no finer tool than Mars—sketch to working drawing.

Mars has long been the standard of professionals. To the famous line of Mars-Technico push-button holders and leads, Mars-Lumograph pencils, and Tradition-Aquarell painting pencils, have recently been added these new products: the Mars Pocket-Technico for field use; the efficient Mars lead sharpener and "Draftsman's" Pencil Sharpener with the adjustable point-length feature; and — last but not least — the Mars-Lumochrom, the new colored *drafting* pencil which offers revolutionary drafting advantages. The fact that it blueprints perfectly is just one of its many important features.



The 2886 Mars-Lumograph drawing pencil, 19 degrees, EXEXB to 9H. The 1001 Mars-Technico push-button lead holder. 1904 Mars-Lumograph imported leads, 18 degrees, EXB to 9H. Mars-Lumochrom colored *drafting* pencil, 24 colors.

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Special Report on I.G.Y. . . . . .

CORNELL'S CONTRIBUTION

- AURORA
- IONOSPHERIC PHYSICS
- SOLAR ACTIVITY

by

Alan S. Rosenthal, EE '60

The inception of the International Geophysical Year has brought an increase in scientific activity at Cornell. Many fields of research in which the university had been engaged have now been coordinated with I.G.Y. research work. Cornell will contribute data to this mammoth scientific effort and serve as a processing center for a portion of the information gathered.

The University's work is concentrated in three areas: aurora, ionospheric physics, and solar activity. These fields are closely related in that they all concern scientific phenomena of the upper atmosphere.

A scientist in the Naval Research Laboratory is operating a Lyot Monochromatic Heliograph, which automatically and continuously records events in the hydrogen alpha line of the solar spectrum on motion picture film.

Cornell is not new to these fields of study. Professor H. G. Booker and W. E. Gordon of the Electrical Engineering department are well known for their present theories on wave scattering in the ionosphere; while Professor C. W. Gartlein of the physics department has spent many years observing auroras and gathering information about them. During this 18 month scientific period, Professor Booker is serving on the United States National Committee for the International Geophysical Year, and Professor Gartlein is working as head of the visual observation center for auroras.

Cornell—Aurora Observation Center

As visual observation center for auroras, Cornell is responsible for the processing of reports sent periodically from observers stationed around this country. In regions where aurora displays are particularly prevalent, data is being taken with cameras, radar apparatus, and several types of spectrographs.

In those regions where auroras are less common, visual observations are being relied upon. Amateur scientists across the country have been encouraged to participate in the program. Those interested in watching for the displays have been instructed in the particular methods of reporting their findings. Pertinent facts regarding each display are recorded and sent to Prof. Gartlein's office at Cornell for further study.

At the processing center, all aurora displays that have been reported are plotted on a large map. This method of operation makes it possible to cross check the accuracy of each report. Further studies of each display can then be made with the aid of photographs and other instrumental data.

What Is the Aurora?

Through previous studies of the aurora, scientists have learned a great deal. The colorful auroras, so frightening to primitive man that he associated them with all kinds of evil occurrences, are the direct result of electrified particles spewed from the sun. These streams of particles collide with the atoms of the earth's rarefied upper air. The atoms, thus excited, give off a glowing light—the aurora!

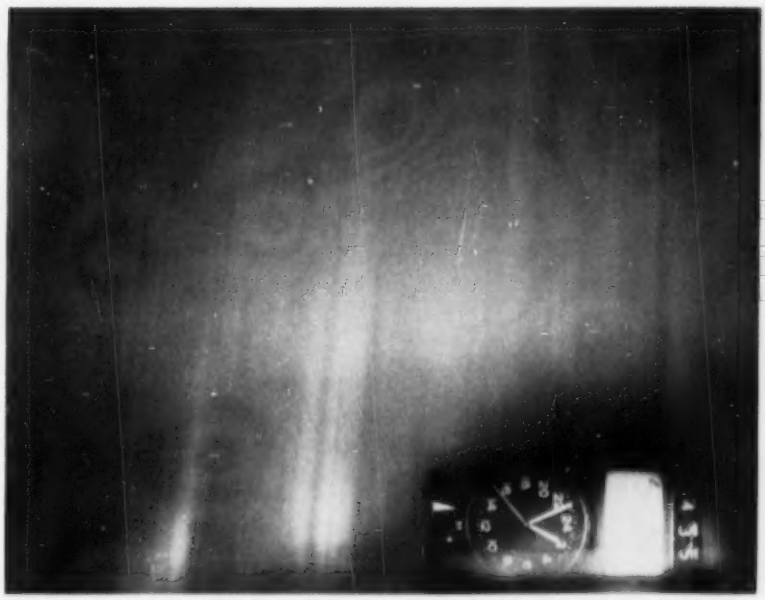
The aurora has many different appearances. In many displays the light is greenish white, while in bright displays it may be yellowish, greenish, or red. In some cases the light forms are stationary; in others they may change in brightness, position, or color. Various descriptions of different auroras liken them to mythical images and weird caricatures. Some observers have been known to call fire departments, believing the glow in the sky to be the reflection of a flaming city.

Another interesting aspect of the aurora's appearance is its height. Although some have claimed to have seen auroras touching the ground, such an observation is an

illusion. No aurora has been measured at a height less than thirty-five miles above the earth. The highest aurora ever measured extended more than six hundred miles above the earth.

Of course, the apparent height and position of an aurora will vary with location. It is this variance which makes it possible to determine the actual height of an aurora. From his observation post at Ithaca, Prof. Gartlein has been collaborating with Prof. C. C. Henshaw of Colgate University to determine the true heights of auroras. The altitudes are determined by comparing pictures taken simultaneously from their different locations.

When considering the location of observation posts, one may ask why Ithaca was chosen as a center in preference to the high Arctic region. There are two primary reasons for a station at a lower latitude. In the far north, it would be impossible to see the aurora for nearly six months of the year because of the lengthy Arctic day. However, more important is the fact that displays as far south as Ithaca are the results of larger solar disturbances than those farther north. Thus it is easier to correlate the auroras with magnetic storms and radio disturbances.



Photograph of Aurora Display over Ithaca taken by Professor Gartlein with the apparatus located on campus.

The Aurora's Importance

While the aurora is very beautiful and interesting to observe, there are more important reasons for its study. In describing the aurora, much was said about its color and height. Both of these aspects provide important clues to the mysteries of the earth.

An analysis of the aurora's light provides one of the methods of determining the elements contained in that part of the atmosphere. The aurora's spectrum not only gives an indication of the elements present but also shows how they are affected by ultraviolet light and particles from the sun.

The height of the aurora provides an important indication of the magnitude of the earth's atmosphere. Through observation of the aurora, it is possible to make accurate predictions of how far upward the atmosphere extends and where—approximately—the vacuum of outer space begins.

But perhaps of most immediate importance to scientists is the aurora's application as a forecaster. Previous studies have already shown that there is a close relation ship between the aurora and magnetic storms. Both seem to be caused by sunspots and their resulting "prominences." The aurora accompanying the sunspots makes it possible to predict with a fair degree of accuracy the intensity of a magnetic storm and the length of time it will last.

The importance of magnetic storms seems to be in their effect on communications. These storms, when severe, play havoc with all forms of long distance communications depending on the ionosphere for reflection and transmission. Accurate prediction of the storms makes it possible to reroute communications to avoid regions of high intensity disturbances. It is interesting to note that a relatively inactive sunspot period during World War II was an extremely important factor in aiding global communications essential to the war effort.

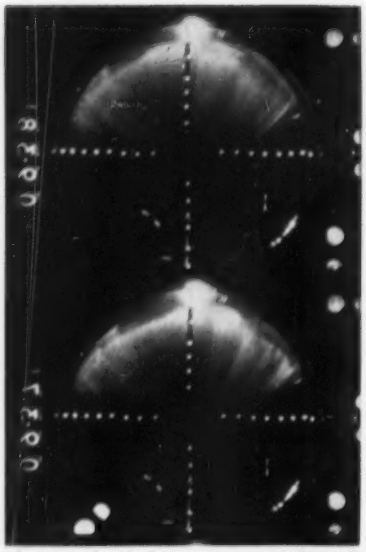
Ionospheric Physics

The question of radio interference is of basic importance to the ionospheric studies being made. It is known that magnetic storms affect radio transmission, but the storms do their damage by disrupting the ionosphere in which the signals travel.

The ionosphere is a region existing from fifty to two hundred fifty miles above the earth's surface. When Marconi was able to send a radio signal across the Atlantic, the existence of an ionoshpere was supposed. It was not, however, until 1925 when a radio signal sent directly upward returned to earth that this hypothesis was proven.

Definite proof of the ionosphere's existence led to extensive studies. Scientists have learned that this region is an everchanging, electrified area encircling the entire earth. The region contains layers of dense ionization which are strongly affected by ultraviolet light from the sun.

It is believed that it is the sun's ultraviolet light which accounts for the ionization of the atoms high in the atmosphere. But how would such a theory explain the ionosphere's continued existence during the dark months of the polar winter? Indeed, this question is one which the scientists hope to answer during I.G.Y. It is already thought that other geophysical phenomenon such as geomagnetism, meteors, or thunderstorms may be important factors affecting the ionosphere.



Photograph of the Aurora over Vermillion, South Dakota, taken with a Kodak all-sky camera.

I.G.Y. Ionosphere Research

The I.G.Y. ionosphere program is quite diversified but may be divided into two phases. The first phase involves regular observations being made at posts set up at strategic points around the globe. The second phase includes special observations being made at locations accessible only through I.G.Y. expeditions.

The type of data that is being taken includes vertical and oblique pulse soundings. An operation of this nature involves sending a radio signal into the ionosphere and recording the reflection on an adjacent receiver. By using the oblique system of sending signals, it becomes possible to extend the area of exploration from six hundred to twelve hundred miles around each location.

While probing the ionosphere, scientists are also studying naturally occurring terrestrial radio noise and whistlers. Whistlers are a special kind of natural radio signal believed to be caused principally by energy from lightning discharges. The propagation path of whistlers extends several earth radii above the earth's surface; consequently, it is hoped to secure information about the amount of ionization, the amount of hydrogen ions, and the path of magnetic fields in this region.

The special observations being made include the vertical and oblique soundings as well as studies to determine the height, dynamic properties, and absorption characteristics of the ionosphere. It is in gathering information about the ionosphere's absorption characteristics that Cornell is playing an important part. The University's ionosphere laboratory is working in conjunction with thirty-three other stations in the United States to gather information for this important phase of I.G.Y. work.

Solar Activity

While studies of the aurora and the ionosphere are tremendously important, it becomes increasingly apparent that the sun has a great effect on both. For the purpose of explaining the sun's effect on the aurora and ionosphere, one may compare the sun to a water sprinkler which, as it revolves, periodically sprays streams of charged particles on the earth. Of course the sun has an immediate effect on seasons and temperatures, but it is the more subtle effects of solar electron emission which are being studied during I.G.Y.

Overall solar activity is measured in terms of the eleven year sunspot cycle. Accompanying a period of high sunspot activity are other solar phenomenon such as flares and prominences. It is interesting to note that the period of time chosen for the International Geophysical Year coincides with just such a period of high solar activity.

The United States' program in solar activity includes daytime patrols by previously existing observatories. Photographs are being taken daily to study sunspots with particular attention to their positions, areas and type. The pictures are also intended to show sunspot magnetic fields and to give a survey of prominences.

Here at Cornell, continuous daytime patrols of solar radio emission are being maintained. The purpose of these patrols is the measurement of mean flux and the study of other outstanding events. Included in the university's studies are interferometric measurements to localize burst sources on the solar disk.

Thus with its participation in three I.G.Y. projects, Cornell will contribute its yards to the many miles of International Geophysical Year data tape that will ultimately be processed.

A Vought Vignette
ONE OF A SERIES

The propulsion engineer who was allergic to switches

During the Vought Crusader's N.A.A. record-breaking flight across the continent, fuel management was a vital factor. But it wasn't the constant worry it might have been. Fred Alvis had seen to that, beginning four years ago.

When the Crusader project was formed, Fred was just a few years out of Alabama Poly. His was still a new face. Mighty new, Fred would have agreed when he was tapped to develop the functional design of the Crusader fuel system.

Navy specs told Fred his system should be reliable and very lightweight. Pilots, too, gave him a special request. In the ready room near the flight line they described the constant in-flight attention required by complex fuel systems. "Can you fix it so we can forget fuel for a minute?" they asked the young designer. "Can you cut down on those switches?"

Fred went all-out for simplicity, plunging into a three-month whirl of schematics. He was encouraged by close design group assistance in studies and layouts. Soon he was making procurement selections and writing functional reports. Then, with the fuel system mockup, Fred unveiled what he'd done.

It was a showpiece of simplicity. Absent was the usual complex CG control system. Fred had bypassed the problem entirely by canny choosing of fuel cell locations and fuel line sizings. Absent, too, was an emergency system — together with the need for it! There was a unique air transfer system for moving fuel from the Crusader wing tank to the main sump, plus some freshly conceived lesser features.

As mockup and flight tests proved, Fred's ideas more than met weight and reliability requirements. And, as pilots were shown, all simplification features led directly to the cockpit. There Fred had won his war against switches.

Only one had survived.

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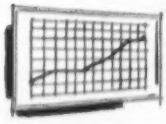
Glenn Seidel, Vice President in Charge of Engineering, B.M.E. Minnesota '36

"Here are some of the facts about Honeywell that have most interested the young engineering graduates we talk to."



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The future is even more challenging. Planned diversification puts Honeywell in such new fields as office and factory automation, process control, plastics, atomic energy, electronics, missiles and satellites.

Honeywell has the proven skills to design, engineer and build the equipment required by an increasingly automatic world and to sell its products profitably.

Year	Sales ($000,000)	Net Earnings ($000,000)	Plant Space (Square Ft.) (000)
1926	1.1	.4	158
1931	5.4	.6	200
1936	13.5	3.0	432
1941	24.3	2.6	603
1946	45.9	5.7	1,284
1951	135.2	8.9	2,296
1955	244.5	19.3	3,460
1956	287.9	22.5	5,365

Honeywell's growth in sales!

	Employees				
Year	Total	Hourly	%	Salaried	%
1926	720*	540*	75*	180*	25
1931	1,150	839*	73*	311*	27*
1936	3,139	2,200	70	933	30
1941	4,240	2,859	67	1,381	33
1946	9,474	6,490	68	2,984	32
1951	17,182	10,796	63	6,386	37
1955	25,608	14,853	58	10,755	42
1956	30,353	17,301	57	13,052	43

Honeywell's growth in people!

RESEARCH AND ENGINEERING ARE IMPORTANT AT HONEYWELL!

One indication of how important research, design-development and product engineering are to Honeywell's continued growth is the fact that over half of Honeywell's more than 12,000 products were not made by the company 5 years ago.

Some of the problems which Honeywell research and engineering *have solved* recently are: the development of variable inlet-air diffuser systems for jet engines, which adjust to the speed of the aircraft, allow such advanced planes as Convair's B-58 to reach design speed; the production of the space reference system for the Earth Satellite Rocket; and the production of the Supervisory DataCenter* central control panel which enables one man in one location to read and control temperatures for even the largest building.

Major research programs now underway at Honeywell include: the development of new techniques and the discovery of new materials to overcome the problems of extremely high temperatures created by high-speed aircraft and guided missiles; the development of automatic control systems for industrial automation; the development of even more accurate navigation systems for aircraft and rockets which may be called upon for intercontinental and interplanetary travel.

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Denver—Oscillographic and Photographic Equipment and Research.

St. Petersburg, Florida—Inertial Guidance Systems.

Seattle, Washington—Ordnance Controls, Missiles and marine research laboratory.

Monrovia, California—Ordnance Controls and Missiles.

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Special Report on I.G.Y. . . . . .

EXPLORING THE FROZEN CONTINENT

by

Jeffrey Frey, EE '60

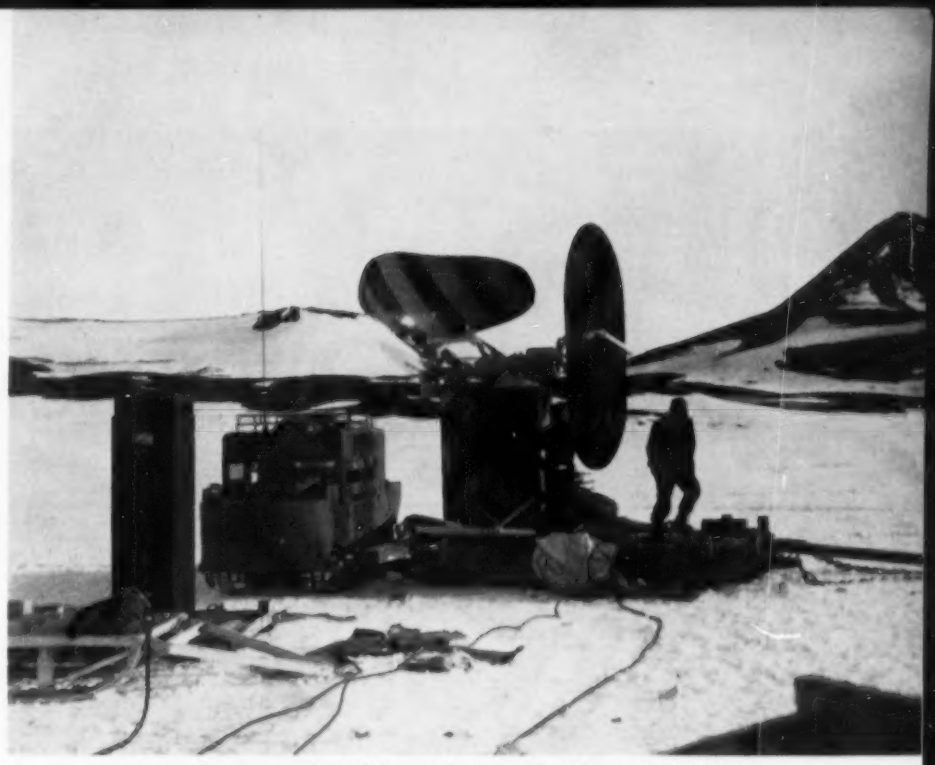
Since the practical purpose of the International Geophysical year is the exploration of both the history of our planet and its present properties, it is natural that concentrated observations should be made of the (to date) least explored region of Earth, the Antarctic continent. Here, in five and one-half million square miles of ice and gravel, lie many mysteries, among them the actual topography of the continent (beneath the thick ice cap); the cause of the present barrenness of the region, believed once warm and fertile; and the effect of the weather in the Antarctic on that of the rest of the world. Here, where the average winter temperature is 45°F. below zero, hardy scientists from the United States and other I.G.Y.-participating countries will try to unravel these and many other mysteries.

U.S. Previous Contributions

I.G.Y. scientists in Antarctica will be helped by the benefits of the greatest expenditure of money and technical skill ever lavished on a polar expedition: the United States has already spent over fifty-five million dollars in setting up and equipping the first U.S. bases in the Antarctic, and will spend fifteen million more to resupply them for the 1957-1958 season. Extensive research

Personnel of "Operation Deep Freeze" lay fuel lines for petroleum oil and gasoline system between the icebreaker Eastwind and fuel storage tanks on McMurdo Sound.

into human behavior in cold climates and into the histories of previous expeditions backs up what this expedition will wear, eat, and do. For instance, US Navy doctors have found that two layers of clothing, one heavy and one light, are most useful in the Antarctic. Long cotton underwear, warmer than wool (and not as itchy) will be worn under the layers; both layers will be used for extremely low temperatures, such as exist at the South Pole itself. Another basic necessity to human survival, food, will consist mostly of rich, energy-giving stuffs, such as candy, desserts, and much steak, based on the doctors' theory that in the Antarctic, men "need to eat twice as much to have half the energy." Finally, men based in the Antarctic will have practically all the comforts of home in their plastic, insulated, pre-fab huts. Hot and cold running water *va sans dire*, accompanying, as they are, indoor plumbing (a *real* convenience in the cold climates), libraries of books and literally hundreds of motion pictures at each station, correspondence school courses, artificial flowers, billiards, electronic pianos, hi-fi phonographs with accompanying records, golf (with black balls) and even fireworks for modest July 4 celebrations. Even with all this, though, there will be plenty of time for scientific observations, both extra and intra-terrestrial, during the 6-month Antarctic "day".



Crewmen work around a Ground Control Approach Unit mounted on a Go-Devil sled for towing to the sea-ice runway at McMurdo Sound.

Extra-Terrestrial Studies

Some of the extra-terrestrial observations to be made will be those of the Aurora Australis, southern-hemisphere counterpart of the Aurora Borealis, the Northern Lights occasionally seen over Ithaca. The southern Aurora will be studied quite extensively in all of its aspects, starting with its geographical extension, to find just how large the Aurora actually is and from what surface points it can be seen with any regularity. Furthermore, the timing of the Aurora demonstrations will be measured, for two reasons: first, to test various theories on the cause of the Aurora (mostly involving particle radiation from the Sun), and second, to find out whether the Aurora Australis puts in appearances at the same time that the Aurora Borealis does. These studies are made with ease in the Antarctic, for it is only there that the display can be observed in its entirety. Finally, the correlation among the Aurora, the weather, and radio interference will be studied, to test the theory of particle production of the Aurora and geomagnetic disturbances. This theory postulates that particles of gas emitted from the Sun interact with the Earth's atmosphere and magnetic field. Studies of the timing of flares on the Sun, radio interference (which usually accompanies these flares) and the Aurora will be made to ascertain the time it takes the particles from the Sun to reach the Earth; the time elapsing between a flare and a magnetic storm will, theoretically, equal the time necessary for a particle's trip between the two heavenly bodies.

Cosmic rays, the ionosphere, and the earth's magnetic field are other extra-terrestrial phenomenon to be studied in Antartica during I.G.Y. Special features of the barren continent make study of these items relatively easy. For example, special observations of the earth's magnetic field are possible because of the location of the magnetic and geographic poles on the continent. Studies of the ionosphere itself will try to determine the effects of the long solar night on these layers of ionized gas particles above the atmosphere. Ionospheric theory now is that solar radiation is the principal agent in breaking the atoms of the atmosphere to form the ions of the ionosphere; however, during the long Solar Night the Antarctic Continent is without solar radiation for 6 months; thus, during this period, observations will be made on the question of whether the ionosphere "thins out" when, according to theory, no ions can be produced. Since the ionosphere is responsible for long-distance radio transmission, studies will be carried out by long-distance radio transmission and radio noise recordings.

The magnetic field of the Earth is scientists' chief instrument for the analysis of low-energy cosmic rays, which are bent by the field in such a way so that these low-energy rays can only enter in high latitudes, i.e., near the poles. Since connections between solar effects and cosmic rays are more conspicuous for low-energy rays than for others, in Antarctica these connections may be studied more fully than ever before, with the possibility of revealing fundamental facts about the origin of cosmic rays, those literal "bundles of energy" from outer space which are

Front view of the crevasse detector operating with an advance trail party.

ever present. The Antarctic program for Cosmic Ray studies includes exploration of the variations in mass & energy of cosmic radiation and variations in the nature of cosmic radiation dependent on location. Varied instruments will be used to effect these studies, among them surface-mounted monitor telescopes (aimable instruments which furnish continuous records of total cosmic ray intensity), balloons equipped with small monitor telescopes, and photographic emulsions flown and exposed at high altitudes, which will give information on various reactions and events which take place in the upper atmosphere.

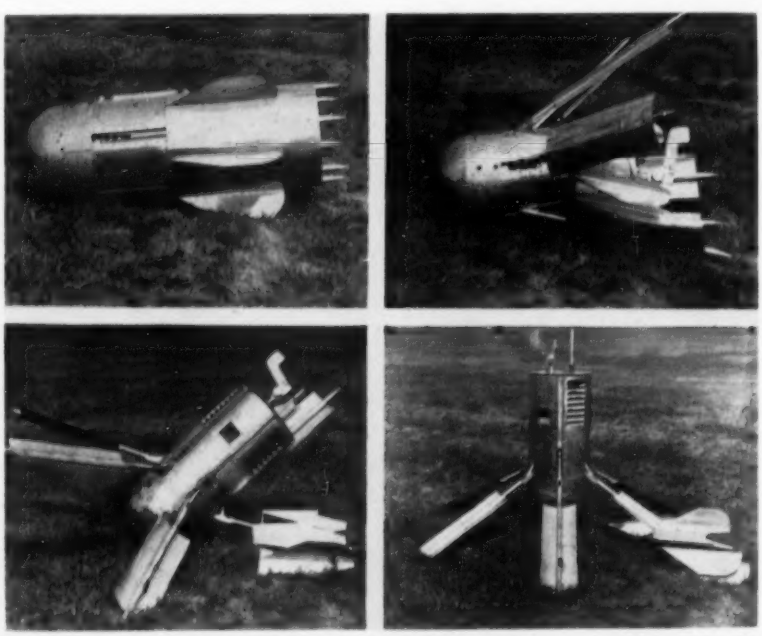
Studies of the magnetic field of the earth itself will emphasize observations providing data regarding time variations of the field. To facilitate this study, recording instruments, called "photographic recording variometers", will be used to make records of changes in magnetic declination, horizontal intensity, and vertical intensity.

The Continent's Own Secrets

The programs of study of extra-terrestrial phenomena, mentioned above, constitute about half of the United States' Antarctic I.G.Y. program. The remaining studies concentrate on the Great White Continent itself: its past, present and future.

Historical studies will attempt to explain why (and when) Antarctica, believed to be a lush green continent at one time, was made as barren as it is today. Theory says that, before the Ice Age, there were great Antarctic rivers, watering the hills of the continent, making the existence of vegetable life possible. This Eden-like existence did not long endure, though, for during the Ice Age, the great rivers drained off into the ocean. To study the outflow of these ancient rivers, oceanographers on shipboard in the Antarctic region will drop corers to the ocean floor; if a corer falls where silt was once deposited by the outflow of a now-extinct river, it is possible to determine from the sample of the core, approximately when the river dried and became a glacial stream. In essence, the corer returns with records of the climates that have hovered over the waters fringing the Antarctic continent in the long past.

Glaciological studies on the Continent will try to determine information on the present volume of Antarctic ice, the topography of the ice surface and the land beneath, the history of the Antarctic ice sheet, and the present trend of gain or loss of ice by the ice cap. Surface movements of the ice will be determined at many points over the continent; the mass accumulation or loss will be recorded at intervals, and deep pits will be dug to determine the relationships between strata of ice. History of the ice will be determined by a deep-drilling



The "Grasshopper" robot weather station will be dropped from an airplane onto the polar ice-cap to provide meteorological information of value in weather forecasting. At upper left, the Grasshopper is shown on impact. Shortly after, its six legs start to open (top right) and operate to erect the station (bottom) and enable it to broadcast back to a base temperature, humidity and wind information.

Rev. Daniel Linehan using the 45-channel seismic recorder at Cape Roydes, McMurdo Sound.

program which, using oil-drilling techniques will bring up samples of ice from far below the surface and the tritium content of these samples will reveal the relative age of the layer from which the sample was dug. In addition, crystal characteristics of the ice will be obtained from these deep samples and temperatures within the ice will also be measured as part of a program to study the mechanisms of energy transfer between environment and the ice cap.

Topographical studies, concerned with the contours of the ice sheet and the land below, will be undertaken both at the fixed stations and by "traverse parties", consisting of groups of scientists traveling over wide areas between stations (as shown on the map). These studies include glacial meteorological observations, determinations of rates of annual accumulation and loss of ice, the structure of the upper layers of the ice sheet, and measurements of the thickness of the ice and the character of the material below the ice. By seismic soundings and the taking of samples of the ice and below-ice materials by the coring method, information will be obtained which will go far toward determining the climatic patterns of the interior of the continent, the amount of water in the ice sheet, the volume of the ice and changes in this volume in recent times, the nature of the sub-glacial floor and the exposed land surface of the continent's interior, and the more familiar variations in distance, elevation and latitude. Already a moderate vein of high-quality Manganese Silicate from which Mn is extracted, has been found near one of the campsites, pointing up the future potential of the as yet unexplored wastes.

Terrestrial studies will probe deeper than just the surface of the continent, however, and as a part of the probing needle a program of gravity measurement will be undertaken at the base on McMurdo Sound. The absolute value of gravity will be determined there in order to form a common and permanent gravity base on the Antarctic continent which can be used as a reference for the measurements of weight and density which will be taken, as a part of the United States International Geophysical Year-Antarctic program.

I.G.Y. Glaciologist holding a snow core obtained from the hand auger dismantled beside him. The core will be used for stratographic and crystallographic study, and chemical and radio-isotopic analysis.

In the study of the properties of the earth itself, gravity measurements will be accompanied by seismographic measurements, to study the inner (and sometimes outer) turbulence of the earth. A network of seismographs in the Antarctic will, in conjunction with ones in the South Indian and South Atlantic Oceans, help delineate accurately the so-called "quake belt" of the Far South, and may thus prevent tragedy in the future.

The final and perhaps most important I.G.Y. study in the Antarctic will be that of the weather of the region, and its effects on weather 'round the world. The I.G.Y. Antarctic Meteorology Program consists of a comprehensive surface and upper-air recording program of weather phenomena, with a daily combination of these observations into a comprehensive area weather map. Three meridional chains of weather observation stations will be set up between the North and South poles to make precise and synchronized weather observations, thus making possible for the first time pole-to-pole atmospheric cross sections, facilitating in turn the preparation (again for the

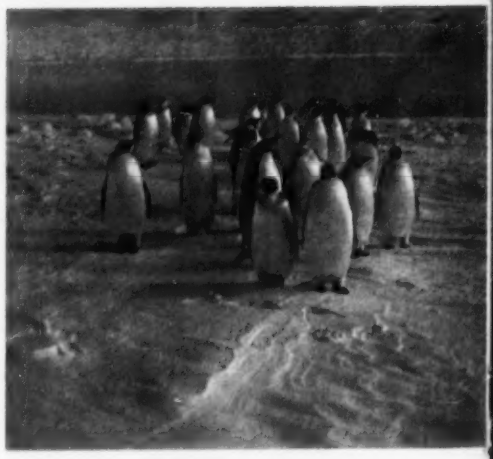
Auger and ice coring kit, used for obtaining cores of subsurface material which reveal much concerning the past climate, vegetation, snow fall, etc., of the region.

first time) of both surface and upper-air weather charts for Antarctica. In addition to this land-based and continuous automatic recording of air temperature, barometric pressure, wind direction and velocity, sunshine duration and total solar radiation reaching the surface, Rawinsonde balloons, small instrument-carrying devices capable of free flights as high as 100,000 feet and utilizing radio for the transmission of data, will relay to base wind conditions, humidity, and air temperature. Supplementary observations will include measurements of atmospheric ozone and carbon dioxide concentrations to help complete the already-comprehensive data gathered.

Information Processing

All of the above information will be relayed regularly to the I.G.Y. Antarctic Weather Central at the Little America Station, where it will be analyzed and published in the form of summary weather reports, distributed to every weather observatory in the Antarctic region. In addition to the Antarctic stations, Weather Central will rely on whaling and expedition vessels, aircraft, and traverse parties for its primary information. This information will be analyzed up to four times each day and will be compared with that gathered by analysis centers in Australia, New Zealand, South America, and South Africa, in order to evaluate the mutual influences of Antarctic and general southern hemisphere circulation, and thus the influence of the Antarctic weather on that of the rest of the world.

The long-range effects of the newly-gained knowledge of such natural phenomena as the Antarctic weather are not yet known, for the International Geophysical Year has, in effect, just begun. Only recently past are the arduous tasks of the Seabees, and now it is the scientists' turn. The science of the Cold Continent has gone far in the last fifty years, but present research will add much to the store of knowledge.



JOB FACTS FROM DU PONT

DU PONT

BETTER THINGS FOR BETTER LIVING
THROUGH CHEMISTRY

OPPORTUNITIES AT DU PONT CONTINUE TO GROW FOR ALL KINDS OF ENGINEERS AND SCIENTISTS

WHERE DO YOU WANT TO WORK?

by
E. H. Cox
Du Pont
Representative

I wouldn't be entirely realistic if I said that you can choose your job location from Du Pont's 75 plants and 98 laboratories scattered over 26 states. But Du Pont does have jobs open in many of these locations, so there is a good chance that we may be able to match your preferences and qualifications with available openings.

Right now, most of the Du Pont units are east of the Mississippi, but we have plants in Texas and on the Pacific Coast, too. In the past year plants were completed in Michigan, California, Ohio and Georgia. New plants are also under construction in Kansas, Tennessee, Virginia and North Carolina. Perhaps one of these locations has just what you're looking for in a job.

For a complete list of our plant locations, please write to me at E. I. du Pont de Nemours & Co. (Inc.), 2494-B Nemours Building, Wilmington 98, Del.

Career opportunities at Du Pont are greater today than ever before because of the Company's continued growth. In 1957, Du Pont's sales were at the *$2 billion* level. Four new plants were being built. New research programs were being launched, and new products were moving into the production and marketing stages. All of these developments tend to broaden opportunities at Du Pont for the young scientist and engineer.

ALL KINDS OF ENGINEERS

Students with chemical engineering and chemistry degrees are needed, of course. But the opportunities are equally great for students majoring in many other fields. And the type of work for these men varies greatly. Among other things:

Mechanical engineers work in research and development as well as in plant engineering and production supervision.

Metallurgical engineers conduct studies in metal fatigue and corrosion and engage in fundamental research into the nature and properties of elements.

Civil engineers have many assignments, including design and supervision of the construction of Du Pont plants and laboratories.

Men studying for degrees in *electrical, mining, petroleum, industrial* and many other specialized fields of engineering will find equally challenging outlets for their talents at Du Pont.

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Du Pont Training Tailored to Individual

Each of Du Pont's operating departments has its own training program because each has special requirements. But both formal and informal programs are tailored to the interests and needs of the individual.

Generally, you go to work on an assignment at once and start learning right away. This headstart on responsibility is an important factor in your progress. Based on your qualifications, you're given one segment of a project to tackle almost immediately. You learn quickly and informally in consultation with your supervisor and other engineers on the same project. This training is supplemented by frequent meetings, seminars, studies of plant operations and procedures.

And since Du Pont is interested in the progress of the individual, your performance is evaluated at regular intervals by your supervisor. These discussions bring out your strong and weak points and together you work out a program for improvement. This training and evaluation continues year after year as you advance in the Company.

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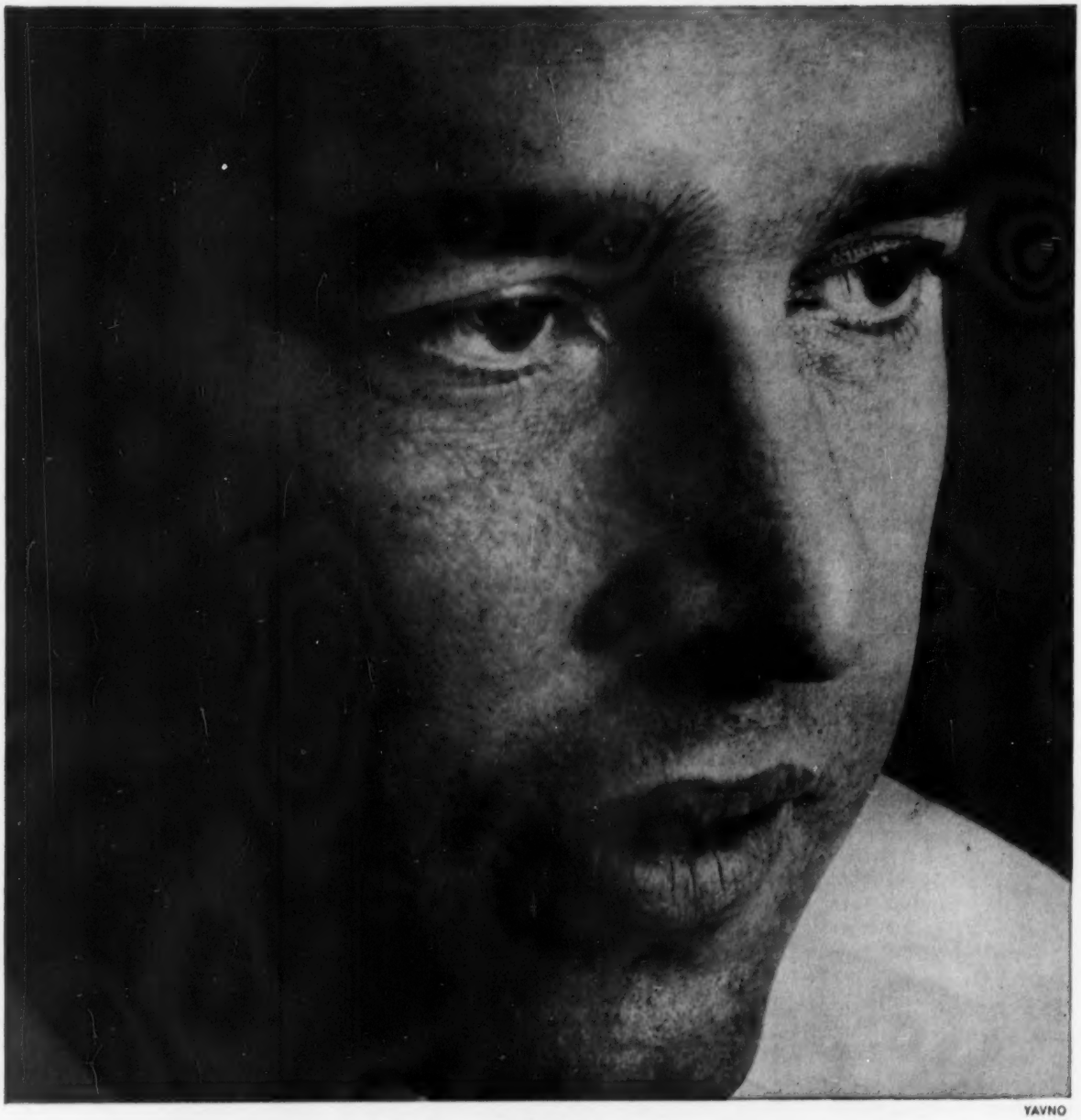
Booklets on jobs at Du Pont are yours for the asking. Subjects include: mechanical, civil, metallurgical, chemical, electrical, instrumentation and industrial engineers at Du Pont; atomic energy, technical sales, research and development. Name the subject that interests you in a letter to Du Pont, 2494-B Nemours Building, Wilmington 98, Del.



YAVNO

...on science and impossibility

"Scientific knowledge is derived from observations of the world. Our imaginations, however, are not bounded by this constraint—we can easily imagine physical nonsense. Not everything is possible. We sometimes get the opposite impression because new scientific discoveries force us to modify an old theory, and give rise to new and unexpected possibilities. But the point is that the old theory was verified for some class of physical phenomena, and a domain of validity was established. The new theory, however radically it may differ from the old one in its conceptual basis, must always agree with the old theory in the predictions it makes for that class of phenomena. Despite the greater generality of quantum mechanics, Newton's laws still apply to macroscopic objects. Parity is still conserved for the strong interactions. The old impossibilities still remain. Within the limits defined by the impossibilities, there is plenty of room for man's inventiveness to operate. In fact, the game is even more challenging that way."

—*Richard Latter, Head of the Physics Division*

THE RAND CORPORATION, SANTA MONICA, CALIFORNIA

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Special Report on I.G.Y. . . .

WATCHING THE WEATHER

by

Harry A. Fertik, ME '59

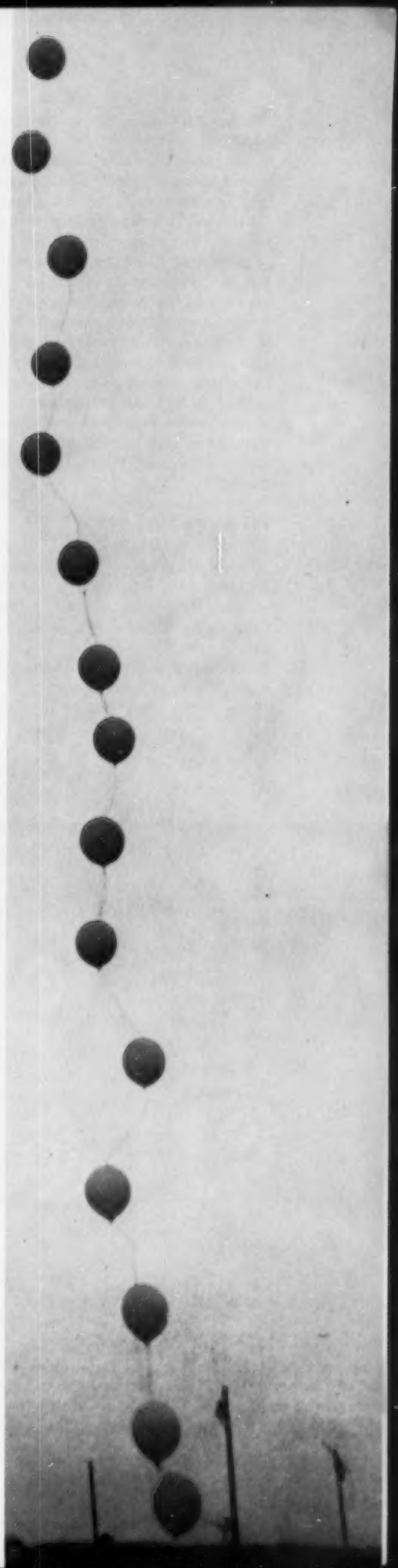
The earth's atmosphere is both tranquil and turbulent, pierced by meteors, cosmic rays and energy waves from the sun, absorbing heat and water vapor, and churning over the mountains and plateaus of the earth. It is capable of an infinite variety of motions, from the thousands-of-miles-long trade winds, to the horizontal waves of the westerlies, to the hurricane, to the rain squall and finally to the softest of breezes. The reasons for these movements, both random and predictable, are not completely understood, but geophysical scientists realize that the answer lies basically in the energy derived from the heating of the air by the sun.

Early Circulation Theories

The tropical and subtropical regions of the earth absorb more solar radiation than they radiate away, while the rest of the earth radiates away more than it receives. Since warm air rises and cool air falls, the atmosphere would seem to rise at the equator, head toward the northern latitudes, sink at the poles and return to the equator. This simple pattern does not work. In fact, global circulation may turn out to be the precise opposite of this elementary scheme!

Classical theories of global circulation are based upon this north-south overturning of warm air and cold air, just as a room with a radiator is warmed by the circulation of the rising hot air and sinking cool air. The deflection of the global air movement by the spinning of the earth results in the easterly and westerly winds about the earth. These principles stem from the classical studies of the 18th-century Englishman, George Hadley.

Recent discoveries using modern



A balloon air-train of 14 Radiosonde balloons is launched in an effort to determine vital weather data collected from the upper atmosphere. Each balloon radioed temperature, pressure and humidity readings to ground stations.

instruments and airborne devices, advanced dynamics and mathematics, and laboratory models unknown to the scientists of a generation ago have modified this classical theory. It is now proposed that near the equator and poles the air circulates in the expected fashion, but in the temperate and subtropical regions the warmer atmosphere moves towards the equator instead of the poles. This means that warm air is falling and cold air is rising. Since this circulation is against the pull of gravity, the atmosphere uses up its kinetic energy to keep itself in motion and cannot supply energy to the easterly and westerly winds.

The Atmosphere's Energy

How is the energy supply of the atmosphere derived? A tentative and controversial answer is that the sun sets the air into motion and the rotation of the earth breaks this air into a complex pattern of big and little eddies like the cyclones and anticyclones of a weather map. The little whirls feed energy into the bigger whirls to produce a general circulation almost the reverse of what is generally imagined. These eddying masses can supply energy because they contain their own independent stores of energy. When a warm mass of air moves into a cool region, the air mass rises converting potential energy into kinetic energy. Applied over a large scale, the movement of warm and cold air masses could be the perpetuator of the general circulation of the atmosphere.

There are no accepted answers to this problem and many of similar importance because man has rarely launched a full attack on these massive questions. In fact, it is absurd to try to predict the general behavior of the atmosphere when small scale behavior in all important respects is still not known.

There is a lack of meteorological observations from deserts, jungles, mountains, oceans, and polar caps to provide the raw data for future studies of this behavior. Meteorologists know that an expanded observational network is necessary before a fuller understanding of their science is achieved; consequently, they participated in the First and Second Polar Years in 1882-83 and 1932-33 and are now giving their wholehearted support to the International Geophysical Year of 1957-58.

I.G.Y. Research

What are some of the benefits that meteorologists hope to receive from their far-flung global undertaking? Of primary importance is an extension of the observation network laterally and vertically to probe the thermal, moisture, and motion fields of the atmosphere. Systematic observations have previously been in restricted areas and then only to altitudes of 20 Km. During I.G.Y. 800 gram balloons are being released to altitudes of 30 Km. at about 100 U.S. stations distributed over the continent, Alaska, the oceans, and several Pacific Islands. Other nations around the world are joining in this massive data collection to bring the number of weather stations to 2,500. The instrument bearing balloons are being released simultaneously at noon and at midnight, Greenwich time, from many of the weather stations. Their paths are then tracked by radar to plot wind speed and direction at each elevation.

These observations should shed some light on the westerlies of the middle latitudes, the winds that determine the west-east air mass distributions. In addition to these zonal motions, the north-south distribution of the atmosphere will be probed to uncover new evidence for a general circulation theory of the atmosphere. A pole to pole cross section of the atmosphere along the 70 to 80 meridian west will be part of a joint Western Hemisphere effort. Under particular scrutiny are the intensity and method of exchange of momentum and water vapor and mass flow between the tropics and the polar regions, between the troposphere and the stratosphere, and between the Northern and Southern Hemispheres.

The establishment of forty or more weather stations in the Antarctic provides the meteorologists

A Naval scientist here prepares to enter the Gondola for his flight to the stratosphere.

with a natural laboratory found nowhere else on the earth. The atmosphere is cut off from direct solar energy for many months, resulting in extremes in radiation, temperature, pressure and wind. Even heat from the interior of the earth is not appreciably conducted to the surface of this frigid continent. The flow pattern of the Antarctic troposphere is still not resolved. It could be a wave system moving like the spokes of a wheel around the Pole or it could be a wave system moving radially outward from the interior of the continent. The vast flatness and near uniform thermal snow surface of the Ross Ice Shelf is an excellent location for the study of atmosphere turbulence and energy exchange between the snow surface and the atmosphere. Other studies will be made of the reflectivity of the snow surface, the atmosphere content of ozone, carbon dioxide, and radioactivity and the net radiative heat flux. In total, meteorologists hope to spell out just what the effect of this great refrigerator is on the world's weather patterns.

"CLASSICAL" CIRCULATION, predicted by older theories, shows air rising in the tropics, flowing north aloft, falling near the poles and returning south along the surface.

A Dependent Science

Meteorology can not be viewed as a science distinct from other geophysical sciences. It is a very large common denominator, linking the oceans to the outer space. The oceans and the atmosphere exchange heat, moisture, momentum, gases, (such as carbon dioxide, and oxygen), and elements (such as sodium, chlorine, potassium, calcium and magnesium). The oceans store heat, moisture and carbon dioxide for the atmosphere, provide salts and minerals that serve as condensation nuclei for clouds, fog and rain, while the atmosphere supplies the surface of the slower moving oceans with much of their momentum.

The outer fringes of the atmosphere are agitated by the incessant bombarding of energetic particles and waves. The ionosphere, aurora, air glow, and geomagnetism are profoundly affected, but whether they influence the atmosphere below is still unknown.

ACTUAL CIRCULATION is predominantly opposite to that in the classical picture. The main body of flow carries air downward in lower latitudes and upward in higher latitudes.

Many Remaining Mysteries

Some geophysical questions can not be answered in a year, or even

(Continued on Page 52)

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What's doing....

One indication of accomplishment in the combustion field: the J-57 engine, augmented by afterburner, provided the thrust which made supersonic flight practical for the first time.

This special periscope gives Pratt & Whitney Aircraft engineer a close-up view of combustion process actually taking place within the afterburner of an advanced jet engine on test. What the engineer observes is simultaneously recorded by a high-speed motion picture camera.

at Pratt & Whitney Aircraft in the field of Combustion

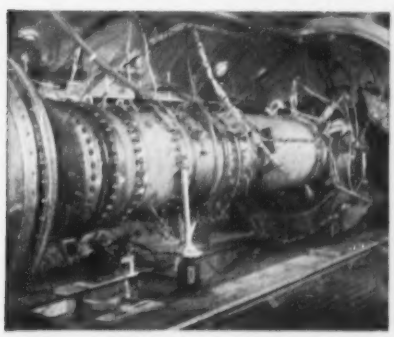
Historically, the process of combustion has excited man's insatiable hunger for knowledge. Since his most primitive attempts to make use of this phenomenon, he has found tremendous fascination in its potentials.

Perhaps at no time in history has that fascination been greater than it is today with respect to the use of combustion principles in the modern aircraft engine.

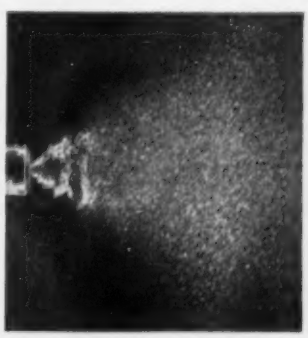
At Pratt & Whitney Aircraft, theorems of many sciences are being applied to the design and development of high heat release rate devices. In spite of the apparent simplicity of a combustion system, the bringing together of fuel and air in proper proportions, the ignition of the mixture, and the rapid mixing of burned and unburned gases involves a most complex series of interrelated events — events ocurring simultaneously in time and space.

Although the combustion engineer draws on many fields of science (including thermodynamics, aerodynamics, fluid mechanics, heat transfer, applied mechanics, metallurgy and chemistry), the design of combustion systems has not yet been reduced to really scientific principles. Therefore, the highly successful performance of engines like the J-57, J-75 and others stands as a tribute to the vision, imagination and pioneering efforts of those at Pratt & Whitney Aircraft engaged in combustion work.

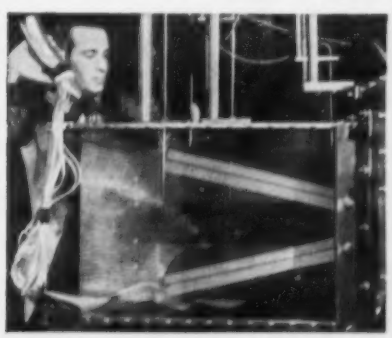
While combustion assignments, themselves, involve a diversity of engineering talent, the field is only one of a broadly diversified engineering program at Pratt & Whitney Aircraft. That program—with other far-reaching activities in the fields of instrumentation, materials problems, mechanical design and aerodynamics — spells out a gratifying future for many of today's engineering students.



Mounting an afterburner in a special high-altitude test chamber in P&WA's Willgoos Turbine Laboratory permits study of a variety of combustion problems which may be encountered during later development stages.



Microflash photo illustrates one continuing problem: design and development of fuel injection systems which properly atomize and distribute under all flight conditions.



Pratt & Whitney Aircraft engineer manipulates probe in exit of two-dimensional research diffuser. Diffuser design for advanced power plants is one of many air flow problems that exist in combustion work.

World's foremost designer and builder of aircraft engines

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"For today's engineer, yes..."

"You are probably the most sought after young men in America today. Industries of all kinds want you. You've got a wide choice, so which field do you choose?

"The way I look at it, the aircraft industry has the most opportunity for you. It combines more advanced engineering sciences than any other field... electronics, communications, propulsion systems, hydraulics and pneumatics, thermodynamics... all these and many others. With this variety, interesting careers can be had either by specializing in one area or by moving from one to another.

"Obviously, you are going to want recognition for your work. You know that the aircraft industry pays well... but think about this: aviation is relatively young and its life-blood is young men with new ideas. Numerous important advances have been made just in the last few years. Who knows what new fields—and new opportunities—today's research will uncover?

"So, for today's engineer, yes, I would say that your best bet is the aircraft industry. Nowhere else can you find such opportunity, such challenge... and such compensation and added benefits. In my estimation, there is no place where you can put your college training to better use."

In the aircraft industry there is such a variety of engineering fields that a desire for virtually any *one* can be satisfied. As research continues more areas will be embraced and, as aircraft engineers pierce these barriers and solve today's problems, new challenges and opportunities arise. Northrop engineers have been meeting these challenges successfully for years. Airplanes such as the F-89 Scorpion, the new supersonic twin-jet Northrop T-38 trainer, and missiles such as the Snark SM-62 are examples of Northrop's engineering theory and capabilities.

In Northrop's new Engineering and Science Center, your training can be applied to top priority projects and your future will be made more secure by intensive on-the-job training. Regular reviews reward you for your capabilities and accomplishments, adding further financial security. The extra benefits at Northrop, such as company-paid insurance and over three weeks vacation with pay, are among the most generous in the entire industry.

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Northrop Division of Northrop Aircraft, Inc.

BUILDERS OF THE FIRST INTERCONTINENTAL GUIDED MISSILE

WATCHING THE WEATHER

(Continued from Page 45)

in a decade of measurement recording. These are the long range trends of atmospheric temperature and climate. Great strides will be taken in discovering the epochal trends in global climate by increasing the magnitude and intensity of measurements and comparing them to similar measurements previously recorded and to those to be taken at a future date. But the ultimate answers can hardly be discovered until scientists are able to take an external look at the earth. The new earth satellite to be launched some time in 1958, will be the focal point for external observations of the earth. It will determine the global heat balance by measuring the incoming solar radiation, the percentage that is reflected and the outgoing solar radiation from the earth and the atmosphere. With measurements over a period of a year or more, scientists should know if the earth is receiving more heat than it is radiating away or vice versa. This excess or deficit will determine the overall global energy balance with the sun that eventually can be translated into climatic (atmospheris, oceanic and glaciologic) trends of the earth.

There is a possibility that the climatic trends of the earth can be influenced by the dumping of mammoth amounts of carbon dioxide into the atmosphere. Industrial and automotive exhausts, together with other sources, can double the amount of carbon dioxide in the atmosphere in the next fifty years if this gas is not absorbed by the oceans. What then, is the rate of absorption of carbon dioxide into the oceans? Can an increase in carbon dioxide upset the thermal balance of the earth by absorbing more radiation and making the earth warmer?

These are just a few of the grave questions confronting the meteorologists stationed all over the world. By synoptic and simultaneous observations and by exchanging information they may be able to answer such questions as: Are cold spells in one area balanced by dry spells in another? How do weather conditions in the Southern Hemisphere affect the conditions in the Northern Hemisphere? Do sunspot eruptions have any influence on atmospheric conditions, and if so, how?

These questions embrace many fields of knowledge. Individual effort has brought the fund of information to a point where little progress can be made without team effort. I.G.Y. has combined scientists from all phases of geophysical research so that they may make complementary and simultaneous world-wide observations to piece together a unified structure of physical nature.

Dr. M. A. Biondi (Massachusetts Institute of Technology, B. S. '44, Ph. D. '49) measuring ultra-microwave transmission through superconductors. This experiment is a joint effort of a group of Westinghouse scientists aimed at obtaining a better understanding of the nature of superconductivity.

Westinghouse Scientists Probe Secrets of Superconductivity, using...

The Coldest Cold

Temperatures within a fraction of a degree of absolute zero are produced routinely by Westinghouse scientists in their search for more knowledge of the important phenomena of superconductivity. These phenomena rank with the nature of nuclear forces as one of the most fundamental problems facing the theoretical physicist. When superconductivity is completely understood, its principles could well revolutionize the electrical and electronic industries.

The basic principles of superconductivity have eluded an explanation since 1911 when the first example of the complete disappearance of electrical resistance in metal was discovered. Today scientists at the Westinghouse Research Laboratories in Pittsburgh, are making significant contributions to the field by their low-temperature research.

Superconductivity occurs in certain metals, alloys and compounds which, below characteristic transition temperatures, completely lose their electrical resistance. While in this superconducting state, they are perfectly diamagnetic, i.e. will completely exclude magnetic flux when placed in a magnetic field.

While this fundamental research is being conducted by theoretical physicists in search of knowledge and understanding of first principles, from even the terse description above of superconductivity, the imagination begins to run wild with engineering applications. An electronic computer using superconductivity memory elements will switch 10,000 times faster than conventional computer elements, will store 10 times as much information per unit space as ordinary computers. If the conditions can be fulfilled to make a substance superconductive in temperature regions other than that around absolute zero, design of every electrical or electronic product will be radically changed. Imagine considering the commonest electrical design problem without having to take into account electrical resistance!

While these exciting considerations whet the imagination, they are not the primary object of the low-temperature research going on at Westinghouse. This and many other research projects are being conducted to discover new phenomena and new knowledge of the universe. It is done on the belief that all research is an investment in tomorrow.

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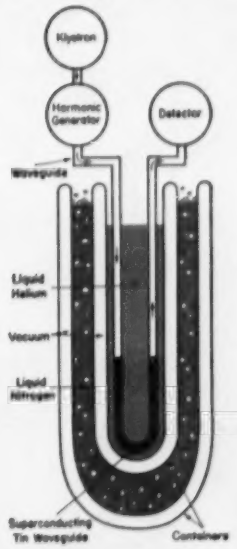

Highly simplified diagram of the apparatus used to study the absorption of millimeter wavelength microwaves in superconducting tin waveguide. Studies of this type have shown the existence of a gap in the energy levels of superconductors. These studies have thus provided key information in solving the puzzle of superconductivity.

For more information on Westinghouse research in the field of superconductors and low-temperature studies, or information on job opportunities, write Mr. J. H. Savage, Westinghouse Electric Corp., P.O. Box 2278, Pittsburgh 30, Pa.

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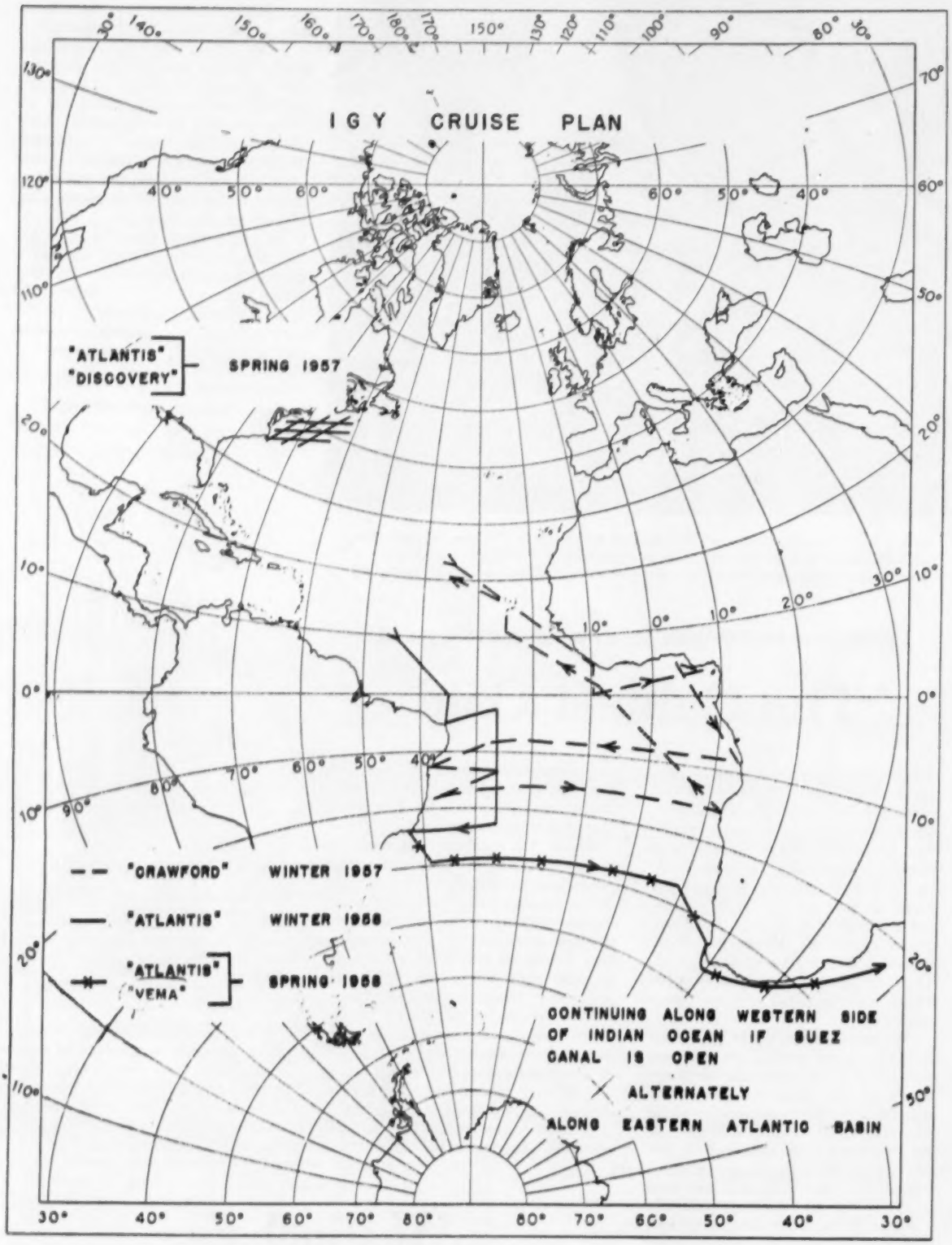
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CONTINUING ALONG WESTERN SIDE OF INDIAN OCEAN IF SUEZ CANAL IS OPEN
ALTERNATELY
ALONG EASTERN ATLANTIC BASIN

Special Report on I.G.Y. . . . . .

THE SEA AROUND US

by

Roy J. Lamm, ChemE, '61

The ocean, man's last frontier on earth, holds many puzzles still unsolved by scientists. The U.S. Oceanography Program for I.G.Y. intends to solve many of these puzzles and increase our knowledge of the water mass that covers seventy percent of the earth's surface.

The major aspects of the program involve the establishment of new tide gauge and long periodic wave recording stations, deep water ship operations, geochemical studies, and Arctic oceanography.

Tide and Wave Recording

The tide and wave recording stations will be set up at selected islands in the Atlantic and Pacific to augment present stations. These island observatories will measure seasonal sea level fluctuations and long period waves. In addition observations of temperature and salinity (salt content) will be made to depths of one thousand feet in the vicinities of the stations to determine what part of the sealevel change is volumetric rather than an actual change in the water mass.

The waves to be investigated will vary from periods of five to fifteen minutes. These waves are related to tsunamis (tidal waves), severe storms, high altitude jet streams in the atmosphere and such occurences as the great eruption of the volcano Krakatau. Surges in the ocean which followed that event were caused by the coupling of energy to the ocean from great pressure waves in the atmosphere. While such catastrophic events are known to be responsible for long period waves, it is theorized that such periodic waves are present to a considerable extent at all times. The wave recording stations will attempt to collect data to substantiate this theory.

Deep Water Operations

Deep water ship operations entail cruises to study the deep circula-

Oceanographic operations are carried on in shirt sleeves inside the "Flying Lab" because of protective tent constructed over the hatch. The bottle is lowered on a cable to the desired depth through a hole in the ice and then turned over to trap sample of water and record the temperature.

tion of the Atlantic and Pacific. These cruises will be conducted by several U.S. oceanographic institutions. Their ships will be floating laboratories for on the spot analysis of samples by scientists.

The deep circulation of the ocean consists of the horizontal and vertical movements of the water mass. These movements influence the climate of the world. An understanding of this circulation, of which we are still largely ignorant, may lead to forecasts of climatic changes similar to the many severe fluctuations which have taken place since the ice age.

The method to be used to study the horizontal movements will be to determine the gradients of current from surface to bottom. This will be accomplished by taking hundreds of temperature, salinity and oxygen content readings at varying depths. Current velocities and directions can then be computed from this data. A more direct method involving neutral buoyancy floats and electric current meters will also be used.

Because the ocean is now being used as a disposal area for atomic waste products, a knowledge of its vertical movements is vital. We know that the ocean is slowly turning over. However, how long does it take for surface water to sink? Estimates range from one hundred fifty to one thousand years. The rapidly increasing uses of atomic energy mean that more atomic wastes will be deposited on the ocean bottom, polluting that water permanently. Thus it is urgent that the vertical movement of the ocean is learned in the immediate future.

Ironically, to determine this movement, fission products deposited in the ocean from nuclear weapons tests will be measured and used as tracers to determine the rate of mixing between layers of water.

In addition to current studies, during most deep water ship operations, echo sounders will be used to provide a continuous record of ocean floor topography. Ocean floor photos, heat flow measurements, and seismic refraction reflection profiles will also be made.

Geochemical Studies

The geochemical program will be conducted at tide gauge stations and at ships involved in deep water operations. Extensive water and air samples will be taken and analyzed for carbon dioxide in order to obtain an accurate world average of carbon dioxide concentration in the atmosphere. These samples will enable scientists to study the processes by which carbon dioxide is distributed in the atmosphere and ocean by wind and current systems. Other information gathered from the CO_2 study will be the water air equilibrium cycle, effects of CO_2 on photosynthetic processes, and the effects of ocean surface roughness on CO_2 exchange coefficients. CO_2 samples will also be tested for radioactive carbon fourteen and stable carbon twelve and thirteen. The carbon fourteen dating process will then be employed to determine the age of the sea water. To facilitate carbon dioxide concentration measurements, an infra red spectrometer has been developed which will be installed on several oceanographic ships making long north south voyages in the mid-Atlantic and Pacific.

Arctic Oceanography

Arctic oceanography will consist of the establishment of two stations on the Arctic ice pack in the vicinities of 78°N 160°W and 85°N 100°W. Gravity cores, water samples, water temperatures and heat exchange data will be collected. As the pack drifts, the surface currents will be computed and depth profiles recorded. From these observations new information on the relatively unknown deep circulation of the Arctic Ocean will be available.

The extent of the ice pack coverage will be studied by plots from aerial reconnaissance flights conducted at two week intervals from March to September, 1957 and 1958.

From the data obtained by this extensive program, along with that gathered by foreign countries during I.G.Y., scientists will solve many of the riddles of the ocean depths.

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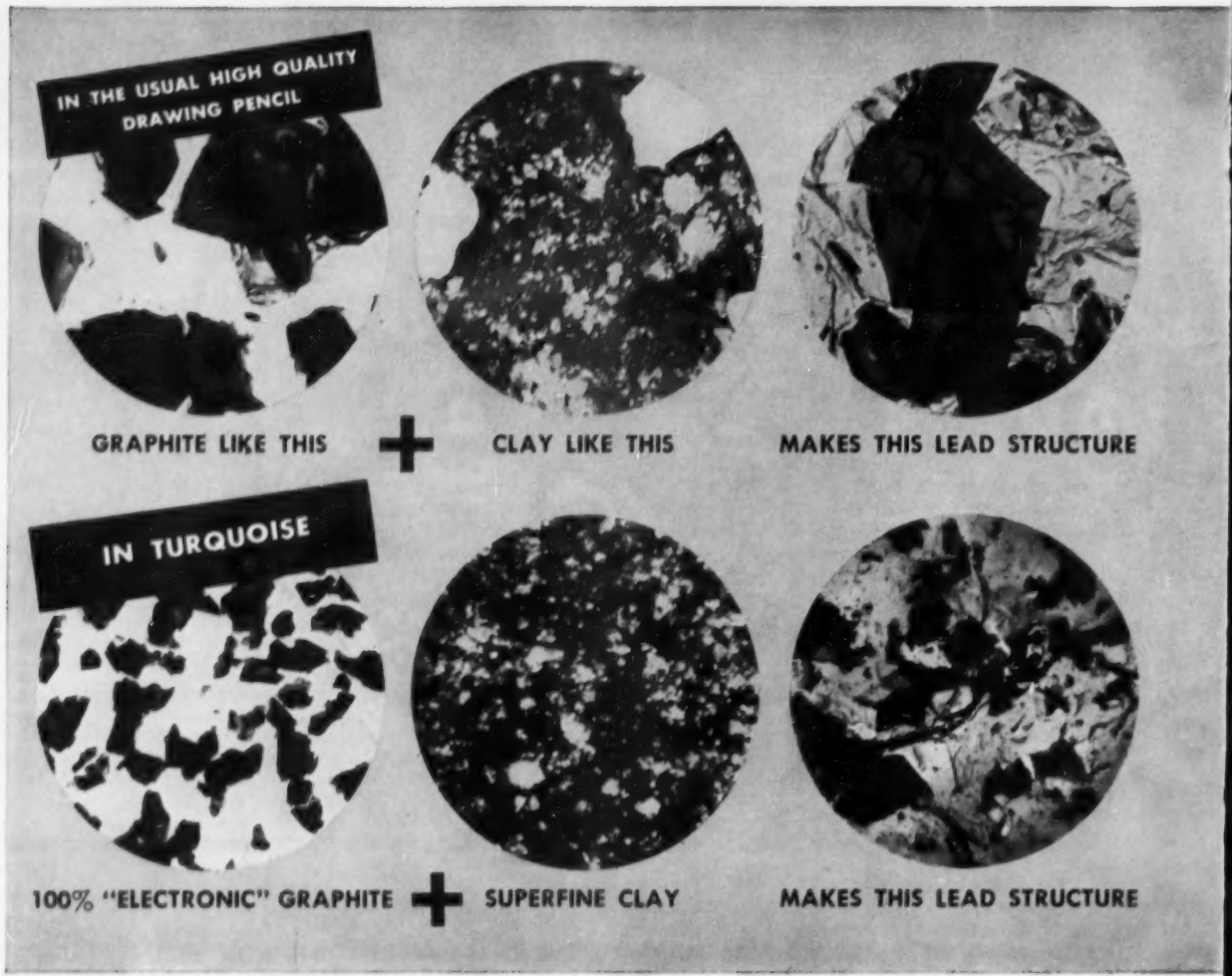

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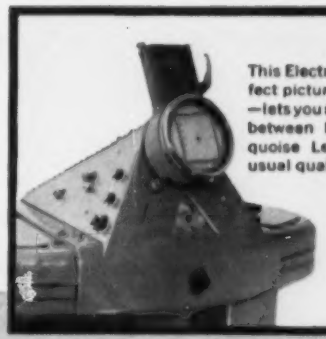

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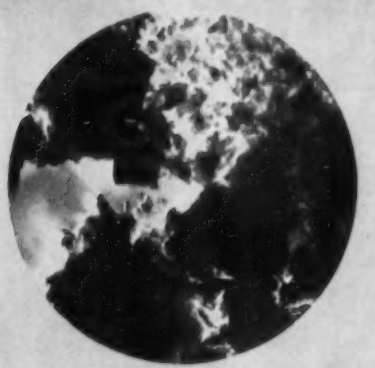

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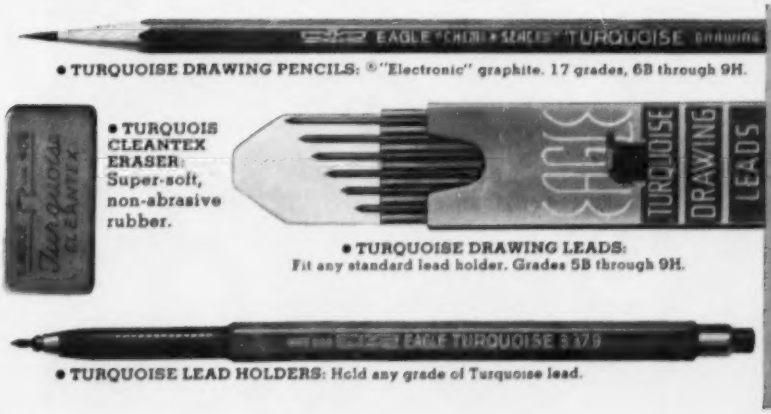

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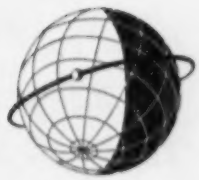

MOUNTAINS OF ICE

by

Barbara Jo Merkens, Arts '58

A glacier is a creeping mass of ice, awesome and silent. It may lie on the slope of a mountain if it is of the alpine variety, or it may cover a whole continent. Our own Lake Cayuga is the product of a prehistoric glacier which carved out a trough and filled it with waves of blue as it melted. Today glaciers are concentrated in the polar areas and high mountain ranges.

It is these areas that are attracting the I.G.Y. glaciologists. These scientists have plotted a program to study the properties and significance of glaciers. They will examine their physical and chemical make-up. They will measure their annual growth and shrinkage. Since there is the suspicion that these enormous crusts of ice might be growing, comparison with past and future measurements will be of interest. I.G.Y. scientists plan to learn more about the effects of glaciers on local and world climate, so that we can predict future weather conditions. Generally speaking, the I.G.Y. glaciology program is the most comprehensive study in the history of the world's glaciers. The product will be a workable collection of observations, statistics, and aerial maps from which conclusions and predictions may be drawn.

Many nations have been studying glaciers for years. These programs will be continued in the International Geophysical Year, their results to be compiled with I.G.Y. findings. Denmark and the U.S. will continue to cooperate in Greenland. U.S. also has teams in Alaska and on the ice pack which cakes the Arctic Ocean. Many nations have flocked to Antarctica, including U.S., U.S.S.R, United Kingdom, France, Norway, Argentina, and Chile. Antarctica is a mystery which intrigues scientists the world over.

The Program's Scope

The I.G.Y. program covers alpine glaciers in Greenland, the Andes, New Zealand, the Himalayas, and Tanganyika in southern Africa. Glaciers in the temperate regions have been retreating in the past half century, indicating a generally warmer, drier climate. Observation preliminary to the I.G.Y. in Washington's Olympia National Park shows that shrinkage in the American Northwest has ceased. Glaciers in that area are growing tens or hundreds of feet a year, the effect of a cooler, wetter climate. One problem then for the I.G.Y. is whether this new trend is universal. The plan is to measure the annual increment or shrinkage and to chart its distribution on aerial maps. Scientists will observe local weather conditions, measuring the net energy exchange at the surface of the glacier and correlating that with the annual growth.

Glaciologist stands in the doorway of a Jamesway hut which serves as headquarters for the glaciologists who are exploring Lemon Creek Glacier near Juneau, Alaska.

The Army Corps of Engineers will be in Greenland studying crevasses, their origin and life cycle. Crevasses present a danger to men studying glaciers. Already two men working in Antarctica have lost their lives falling into these cracks in the ice. The Engineers Corps offered a training program for I.G.Y. scientists in the glaciology program. They covered obtaining and evaluating snow measurement, the use of instruments, and—for their own good—the use of trail equipment, clothing, and living on an ice cap.

Antarctic Glaciology

Operation Deepfreeze is our part in the I.G.Y. investigation of Antarctica. Preparation has been in progress since the South Pole summer of 1955-56 when the Navy sent volunteers into the God-forsaken whiteness to construct stations for I.G.Y. scientists. The following year U.S. scientists began to arrive. The summer of 1957 saw the launching of the I.G.Y. in full swing with ten nations at 39 stations cooperating.

(Continued on Page 66)

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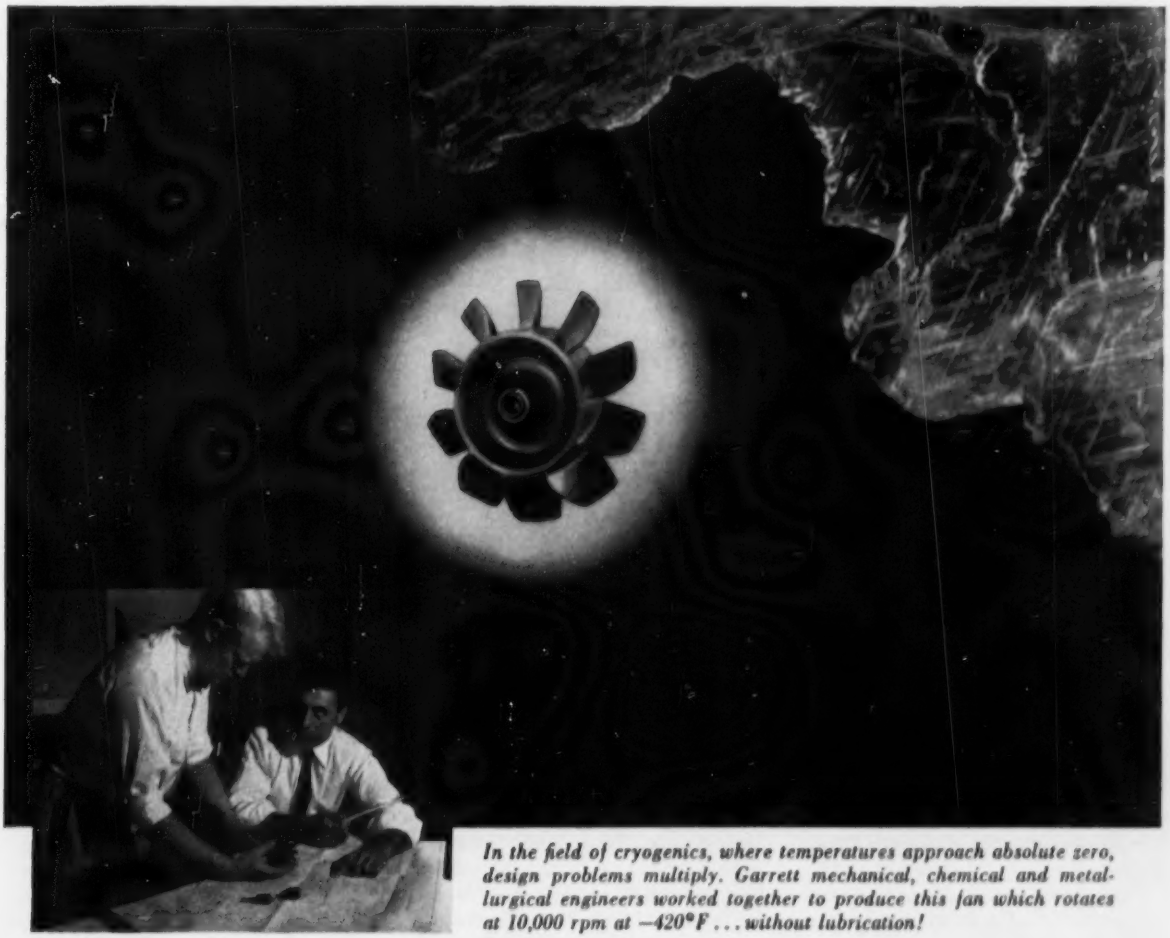

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Special Report on I.G.Y. . . . . .

GRAVITY and SEISMOLOGY

by

William B. Easton, EP '60

The I.G.Y. gravity program includes pendulum and gravimeter measurements for gravity standardization on a global basis, including studies of polar and other unexplored regions, for use in studying the geoid[1] and as part of other investigations, submarine pendulum and gravimeter measurements, and studies of earth tides and their relationship to geology and earth structure.

The gravity standardization measurements can be divided into two parts, the establishment of a network of standard reference points by means of pendulum measurements and the establishment of an international network of gravity control bases.

Pendulum Method

The pendulum method provides an independent first-order determination of the acceleration of gravity; such a determination is necessary for the calibration of gravimeters.

Work along this line was started some time before the beginning of the I.G.Y. under the Air Force Cambridge Research Center. This program includes measurements with the compound quartz pendulum equipment built by the Gulf Research and Development Company, which affords a determination of the acceleration of gravity which is reliable to within one-half milligal.[2] This work is currently being done by the University of Wisconsin-Woods Hole Oceanographic Institution group along north-south lines. Measurements have been completed so far from Oslo, Norway, to Capetown, Union of South Africa, and from Fairbanks, Alaska, to Paso Cortez, Mexico. It is planned to begin a new line of measurements from Thule, Greenland, extending down the eastern coast of North and South America to Cape Horn and another from the Aleutian Islands along the eastern coast of Asia through Australia to Antarctica. The Alaska-Mexico line will be continued down the west coast of South America to Santiago, Chile.

Complementary measurements at the same sites are to be made with Cambridge University's compound, magnetically-compensated Invar pendulums. These measurements have already been made with the pendulum equipment of the U.S. Coast and Geodetic Survey. Although the three sets of equipment differ radically in design, the results are in excellent agreement over the entire range.

Gravimeter Measurements

Measurements with gravimeters may be made with much grreater ease than pendulum measurements —about five minutes for a reading as compared with about two days for a pendulum measurement. The instruments must, however, be calibrated against pendulums or other first order stations, since the measurements are relative.

The anticipated coverage of pendulum stations will permit the establishment of new second-order networks and connections between existing nets by means of the gravimeter. Such measurements are being made principally by the Woods Hole Oceanographic Institution under the Office of Naval Research and by the Expéditions Polaires Françaises. These measurements will be used to check the accuracy of various national gravity bases, establish a world network of gravity bases for reference purposes to tie existing gravity data to a common datum, and to establish regional control points for future work in areas for which there are no data.

Although the University of Wisconsin-Woods Hole Oceanographic Institution group has made over three thousand measurements, much of the earth has not been covered. For example, no measurements

Scientists from the Dominion Observatory determining the acceleration due to gravity in the basement of Rockefeller Hall at Cornell. Dr. L. G. D. Thompson (right) and P. J. Winter found a preliminary figure of 32.1621 ft/sec^2; the exact figure will be recorded on a bronze plate in the floor.

have been made in areas under Communist control; it is hoped that measurements can be made in these previously politically inaccessible areas during I.G.Y. Such measurements will do much to resolve the uncertainty concerning the actual shape of the geoid.

Gravity measurements will be carried out as part of the general glaciological program in Antarctica. Seismic and gravity measurements will be made as part of the study of the ice and the underlying bedrock. The gravity measurements will be used to determine the approximate ice thickness in support of the seismic measurements; this is especially important in regions of poor seismic reflections.

Submarine gravity measurements will be made with both gravimeters and pendulums as a supplement to the land areas study and as a means to study the structure of the continental shelves, island arcs, and the parts of the earth's crust that are covered by deep water. Much of this work will be done by the Lamont Observatory of Columbia University using the Vening-Meinesz compound pendulums. Other marine measurements will be made from two floating ice-floe stations in the Arctic Ocean.

The object of the earth tide studies is to determine the rigidity of the earth at tidal periods of approximately 12 to 24 hours. The gravitational solar-lunar tide will be observed with two special LaCoste-Romberg gravimeters which will provide a sensitivity about ten times that previously obtainable, but which are relatively insensitive to the high level of microseisms encountered at island stations in mid-ocean. These measurements will be especially valuable if taken during I.G.Y., as it will be possible to correct the results for ocean tides and meteorological conditions.

In addition to the direct gravimetric studies, it is hoped that some observations of the I.G.Y. Earth Satellite Program may contribute to our knowledge of the earth's gravitational field and related work.

Seismology

Seismology is the study of elastic waves or vibrations in the earth, the origin of these vibrations, and the manner of their propagation. The I.G.Y. seismology program will include studies of earthquakes, seismic studies of the structure of the earth's crust through both earthquakes and artificially created disturbances, and studies of microseisms.

There are now about three hundred seismograph listening stations in operation throughout the world; at least twenty more will be completed during I.G.Y. As the majority of the stations now in existence

are, quite naturally, located near areas of known earthquake activity and in more densely populated areas of the earth, it is hoped that some new stations will be built in sparsely populated regions.

A large amount of work on the problem of forecasting earthquakes will be done during I.G.Y. Advances in the past few years, due mostly to the work of the California Institute of Technology, have dealt mainly with the accumulation of earthquake energy in local regions or over broad areas. The characteristics of the change of accumulated energy with time are studied, and a simple mathematical relationship, which can be extended into the future, is found. The difference between this theoretical curve and the known energy release is, then, a measure of the energy available for earthquake production. Specialized equipment is now being built which will measure the strain directly.

Recent advances in equipment design have made possible the study of very long period earthquake waves. Waves created by large earthquakes may have periods of six or seven minutes and amplitudes up to one-half millimeter.

In the second phase of the I.G.Y. program, earthquake waves are put to scientific use. As they travel through the earth, these waves are refracted and reflected according to their velocities and according to the density of the earth. Through the study of travel times and of the character of the vibrations at various distances from the shock, seismologists can obtain information about the velocity of propagation and about the densities of various parts of the crust and the interior of the earth.

Earthquakes, however, have a nasty habit of picking their own time and place, thus creating a difficult problem in logistics. Unfortunately, the seismologist's delicate equipment is not easy to transport to the scene of an earthquake. A program is, therefore, underway to study the structure of the earth's crust by means of seismic waves produced artificially with explosive charges. Studies of the crust to a depth of thirty or forty miles may be made by this method, which has been used in oil exploration for many years.

Areas slated for study by artificial explosives include the crust under the Atlantic and Pacific Oceans, coastal regions and margins of ocean basins, and certain continental areas.

Microseisms, the cause of the high background noise found in earthquake recordings, are the gradually appearing and disappearing rumblings or background vibrations of the earth. They are quite dissimilar to earthquakes in that they contain no sudden bursts of energy. In the last twenty years, it has been found that microseisms are due mainly to atmospheric disturbances, such as severe storms. Although the available data on microseisms will be greatly increased by information from the new seismological stations and by the increased meteorological and oceanographic studies, no specific project is planned during I.G.Y. to study them.

Extensive research will be carried on in the Antarctic region. Stations will be installed at Byrd, Pole, Knox Coast, and Adare Stations, if local conditions allow. In addition to providing information in a previously unexplored region, these stations will give valuable data on the average ice thickness, microseisms, and the impulsive energy developed by movements of the ice.

Portable seismographs in Antarctica will complement glaciological studies during the Antarctic summers. They will be used to measure the thickness of the ice, the depth of the transition between the top and the underlying ice, and to determine the velocity of the elastic waves in the subglacial floor from which the nature of the bedrock can be ascertained, or, in the case of floating shelf ice, the depth of the water beneath it.

These detailed studies of seismic waves and of the earth's gravitational field are only a small part of the thorough "going over" that our world will receive between now and July, 1958, but the information accumulated will be useful not only in these two fields, but in many others, when it is considered along with data from other programs.

[1] *Geoid:* A hypothetical figure of the earth with the entire surface reduced to mean sea level.

[2] *Gal:* The c.g.s. unit of acceleration. One milligal, therefore, equals 10^{-6} cm-sec^{-2}.

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MOUNTAINS OF ICE

(Continued from Page 61)

One question about the Antarctic ice cap is whether or not it is expanding. Till now it was believed stagnate. In their search for the answer seismologists from several nations, including U.S. and U.S.S.R., crawl across the ice on huge tractors painted orange for visibility. Every few miles they set off an explosive charge. The interval between the charge and its echo from the underlying bedrock is a clue to the ice thickness. In this manner it has been discovered that the Ross Sea Ice Shelf is 800 feet thick, and the bay beneath it is 1250 feet deep.

In order to study the properties of the Antarctic glacier, teams drill down 300 or 500 meters for cores of ice. These are sent to the Engineers Corps laboratory at Wilmette, Illinois. Scientists there study grain shapes and analyse deformation to determine the mechanics of flow in the glacier. California Institute of Technology gets these cores to analyse the isotope oxygen content, which is the index of temperature at the time of precipitation. Studying layers upon layers of ice, scientists can derive information on climatic history of 500 to 1000 years back.

These then are the objectives of the I.G.Y. program for glaciology: to collect data into a comprehensive survey; to give us new insight into chemical and physical make-up of glaciers, their flow, their history; and to enable us to predict future growth or retreat, and future effects upon the world's climate.

CORNELL SOCIETY OF ENGINEERS

Roscoe H. Fuller

"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates and former students, and to establish closer relationship between the College and its alumni."

THE PRESIDENT'S MESSAGE

In looking at our College of Engineering and taking stock of its accomplishments over the years, we have a right justly to be proud. Our enrollment, starting at less than 100 students when the University opened in 1868, has reached about 1900 as of the current year.

The 18,000 Cornell engineering alumni are perhaps our college's greatest asset, representing as they do men of prominence in nearly every line of endeavor.

Within the last twenty years great changes have taken place in our profession. More and more technical fields have opened, and the fields of usefulness of the engineer has broadened considerably. Ever wider is the realization that engineering training offers the best background for successful operation in management, administration and related areas not directly concerned with technology.

Our college has kept abreast of these developments. Curricula in nine different engineering disciplines are now offered to undergraduates. Postgraduate work and research are continually expanding.

Thirteen years ago it became obvious that a wider base of engineering was needed as well as stronger instruction in the collateral fields of economics and the liberal arts. The decision was made at that time to institute the five-year program in all branches of engineering at Cornell. Cornell was a pioneer in this decision, and the statement has been made that only Cornell would have been able to succeed in such a radical undertaking. That it has been completely successful, and a major step forward in engineering education is clearly indicated by the annual tabulations of starting salaries of engineering graduates from different institutions.

In 1940 it became obvious that the space available at the north end of the quadrangle would never be adequate for the expanding needs of the Engineering College, and the decision was made to abandon various earlier plans for expansion, and to relocate at the south end of the campus. Olin Hall, started in 1941, was the first step toward implementing this program.

We have now eight buildings occupied or under contract, which will make it possible within the next two years to vacate all of the buildings at the north end of the campus now used for engineering, except for the foundry. With the relocation of the School of Industrial and Labor Relations, which is contemplated as soon as other quarters become available for it, we shall have a largely self-contained engineering quadrangle.

The realization of these objectives has been due largely to the vision, determination and single-mindedness of one man. Though assisted greatly by the generosity and strong support of a number of staunch Cornellians, it was nevertheless he who conceived the basic ideas and who is chiefly responsible for having carried them to execution. I refer, of course, to our Dean.

In two more years, Dean Hollister will retire. It is hoped, before that date is reached, to provide quarters for Metallurgical Engineering adjacent to Thurston Hall, to provide and house a nuclear reactor for instruction in that field, and to provide apparatus and equipment still needed to complete the instructional facilities. The total amount required to complete the Engineering Development Program is some $1,500,000.

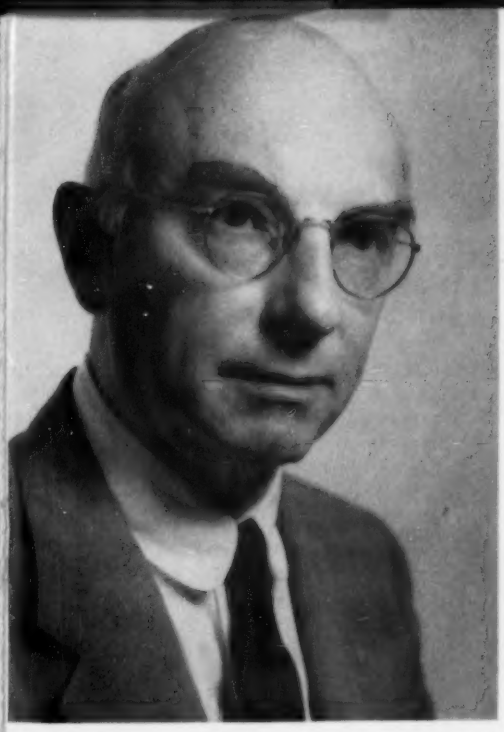
Many Cornellians, unable to endow so substantial a gift as a building, have expressed a desire to assist in this undertaking. It is to them; to all of us, in fact, that an opportunity will shortly be offered to subscribe to a share in this valuable work.

More detailed information will be forthcoming through other channels, but pending a formal solicitation, give thought to the need, to the greatness of Cornell and its engineering tradition, and to the share you would like to have in its Engineering Development Program. Donations for this purpose supplementing your regular gifts to the Alumni Fund are earnestly needed to complete the work so brilliantly begun.

No amount is too small to be put to good use in achieving this important end. To those who wish to contribute more substantially; who want to "build themselves in" as co-sponsors of the new and greater College of Engineering, the opportunity is offered to subscribe for "share units" in increments of $500. The names of those who do so will be made a part of the permanent archives of the college.

Only 3,000 share units from a body of 18,000 alumni will complete the job, and if those of us who are able will contribute each in accordance with his ability, completion of the task before us will be rapid, and we shall share that feeling of being a part of a great institution which this opportunity makes possible.

Give thought to the need! Let's build ourselves in!



Faculty Profile . . .

Professor C. W. GARTLEIN

by

Alan S. Rosenthal, EE '60

One of Cornell's most enthusiastic supporters of International Geophysical Year is Dr. Carl W. Gartlein. A well known worker in the field of aurora, Dr. Gartlein is presently in charge of the visual observation section of aurora studies during I.G.Y. It is this work which has called him to the Antarctic for a tour of inspection of the stations.

Born in Connersville, Indiana in 1902, Dr. Gartlein is the father of three children, one of whom is a freshman at Cornell. He began his early studies at DePauw University, where he received his B.A. Completing his undergraduate work there, he came to Cornell, where he got his Ph.D. in physics.

After finishing his graduate studies at Cornell, Dr. Gartlein accepted a position here as a physics instructor. He taught undergraduate physics for several years and then became Curator in Physics. He then held the position of Superintendent of Technical Service Personnel and later served as technical adviser on research and facilities in physics.

During the past years, Dr. Gartlein has become a member of the American Physical Society, the Optical Society of America, the American Geophysical Union, and the American Association of Variable Star Observers. He is also a member of Sigma Xi and Phi Beta Kappa.

Dr. Gartlein's work in the field of aurora studies began in 1938 as Director of National Geographic Cornell Study of Aurora. Naturally, this position has kept him busy.

With the help of his wife, he has built, at his home, an elaborate aurora observation center. When first built, the laboratory employed a good deal of manual equipment, the use of which often proved inconvenient. On many occasions, Dr. Gartlein and his wife had to stay awake for an entire night in order to photograph a complete display. Now, however, automatic equipment eases their work considerably. Unfortunately, such equipment has the disadvantage of recording the light of burning buildings and other extraneous phenomena.

Dr. Gartlein derives a great deal of pleasure from his aurora observations with Professors Henshaw and Berkey of Colgate University. It is not uncommon for one to telephone the other in the middle of the night in order to observe a particularly bright aurora. An observation of this type is a fairly complicated procedure. Dr. Gartlein first determines an aurora's brightness, and then the observers decide upon camera settings. When everything is in order, photography begins.

Through this procedure, the observers have taken more than three hundred pairs of pictures. While making observations of this type, the men keep a telephone line constantly open. Dr. Gartlein often chuckles as he recalls his surprise at hearing Colgate football rallies over the phone. Another time Professor Henshaw heard a flock of geese passing through the sky before they crossed his camera's field of view.

Dr. Gartlein's experiences have enabled him to be a very understanding director of visual aurora observations during I.G.Y. Realizing the difficulties involved in making an observation, he has formulated an original method of marking reporting cards. The cards provide a clear, concise, yet simple method of presenting aurora data.

Besides their required reports, Dr. Gartlein's nationwide family of observers sends pictures of auroras. Often included in these picture summaries are personal pictures of the observer and his apparatus. Each astronomer has a great deal of justifiable pride in his instruments. During our meeting, Dr. Gartlein showed me several unusual set-ups for aurora observation. One party had a one-man post built on the roof of his house. "Why is the observation booth so small?" I asked.

"I guess that's all he needs," re-

plied Dr. Gartlein. "He's a bachelor."

During one of Dr. Gartlein's meetings with I.G.Y. scientists from other countries, his observer program evoked the admiration of the Russian scientist working with a similar project. He was impressed with the United States' method of reporting data and decided to incorporate some of these ideas into his own plans. Dr. Gartlein, in turn, was able to see some of the innovations in Russian cameras and hopes to use some of these changes in our program.

Dr. Gartlein was impressed with the friendship and understanding he and the scientist were able to gain. The two men communicate regularly now, Dr. Gartlein writing in English, the other communicating in Russian. ". . . that way we know that if the interpreters get things bungled, we've still got the original letter, and it's correct!"

With the U.S. aurora program well under way, Dr. Gartlein with five other scientists is on his way to the Antarctic. He will be there during the six-month Antarctic day and will not see any displays; however, the purpose of his trip is to check operational procedure in that region.

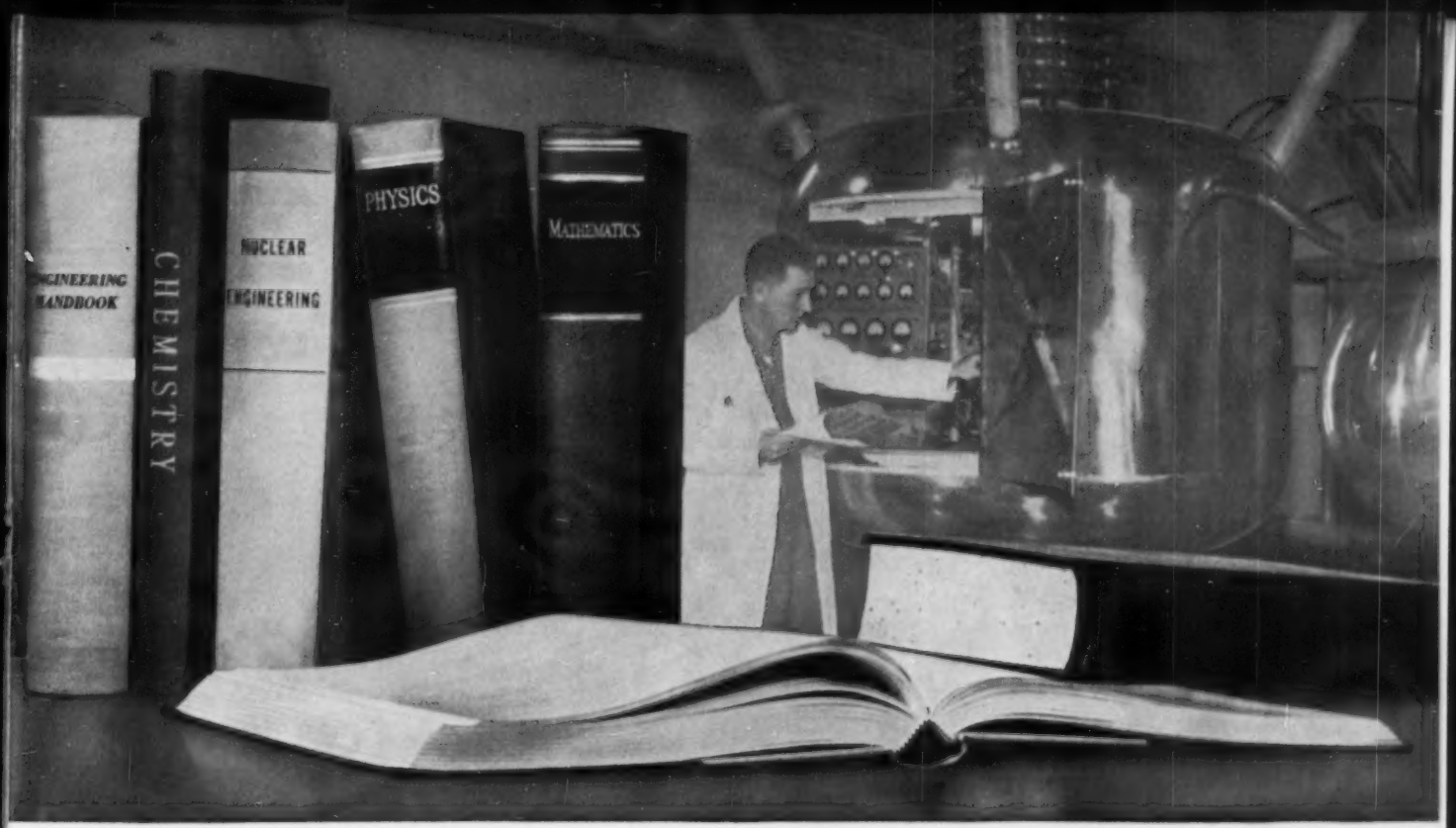
The first leg of this trip will be made by plane to New Zealand. Here he will be able to make personal observations of what he hopes will be vivid New Zealand displays. After ten days at New Zealand, the doctor will again board a plane; this time bound for the Antarctic outpost.

While we were talking, Dr. Gartlein took out a long list of instructions from Washington regarding the trip. The instructions included an itemized account of the myriad items he will be issued. "I just sent my eyeglass prescription down to Washington," he exclaimed. "They're giving me two specially ground pairs of sun glasses!"

"I don't suppose your wife will be able to go with you on this trip?" I queried.

"No," he replied sorrowfully, "maybe some other time."

But then it occurred to me—Mrs. Gartlein would have to remain in Ithaca. After all, who else could do an adequate job of maintaining the Ithaca aurora observation post?



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ALUMNI ENGINEERS

Dan C. Kline

Dan C. Kline, CE '25, (above), Box 247, St. Ignace, Mich., is erecting manager, American Bridge Division, at Roanoke, Va. He has recently been project manager for the erection of the Mackinac Bridge. He first started with American Bridge in 1926.

G. T. Hepburn, EE '25, 47 Union Street, Apt. 306, Montclair, N.J., is rounding out 32 years with the long lines dept. of American Tel. & Tel. He has three children and three grandchildren. His youngest, Dick, is flying for the Navy in Texas.

Francis N. Bard, ME '04, is president of Barco Manufacturing Co., 500 North Hough Street, Barrington, Ill. In addition to manufacturing railway supplies and metal specialties, the company has been active in the aviation and missile fields. Bard is donor of the Francis Norwood Bard Professorship of Metallurgical Engineering, now held by Professor George V. Smith.

Rudolph E. Prussing, ME '04, is retired and lives at 999 Lake Shore Drive, Chicago 11, Ill. He was in Ithaca June 10 to attend the graduation of his granddaughter, Susan P. Howe '57.

Edward T. Foote, ME '06, is vice-president of Globe Union, Inc., manufacturers of storage batteries. Address: 4100 North Lake Drive, Milwaukee 11, Wis.

Joseph O. P. Hummel, '26, has joined the firm of Haller, Raymond & Brown, Inc., State College, Pa., serving as director of operations research. The company specializes in electronics research design. For the last three years, he has been with the operation research office at Johns Hopkins University. Prior to that, he had been an industrial engineer for Westinghouse Electric Corp., an associate professor in the department of industrial engineering at Pennsylvania State University, a member of the management consultant division of the War Production Board, chief of the wage incentive section, U.S. Department of Commerce, and in 1950 he became a faculty member and research engineer at University of Florida. He is a fellow of the Society for the Advancement of Management, a member of the American Institute of Industrial Engineers, as well as of the Institute of Management Sciences and the Operations Research Society of America.

Arch G. Shaver, Jr., EE '27, is with Illinois Bell Telephone Co. His address is 217 South Albert Street, Mt. Prospect, Ill.

F. Howard Cusack, EE '29, 11 Hickory Street, Spring Valley, is contracts and services engineer, research and development department, Western Union Telegraph Co., New York City. He and Mrs. Cusack celebrated their silver wedding anniversary August 17.

Ronald C. Brown, ME '33, Mt. View Manor, RD 2, Fishkill, N.Y., is manager of the administration services department of the Military Products Division, International Business Machines Corp., Kingston. He joined IBM as a machine assembler in 1933. Brown is also president of the Wappingers Central School Parent-Teachers Association and vice-president of the Cornell Club of Dutchess County.

Gerhard Sonder, B.M.E. '48, is supervisor of compressor design on the T-58 gas turbine engine, small aircraft engine department, General Electric. His address is 54 Boylston St., Cambridge, Mass.

John B. Upp, C.E. '49, has recently been made district manager of New York State for Intrusion-Prepakt Co. With offices at Ithaca he will be in charge of the company's sales, engineering and operations for this state.

Clarence W. Shonard, Ch.E. '49, has joined the staff of the Silicones Division, Union Carbide and Carbon Company located at Tonawanda, N.Y. His present assignment is in process development. Prior to joining Carbide he was associated with Imperial Paper Co.

Frank A. Ernandes, EE '56, has been awarded a Hughes Master of Science Fellowship enabling him to continue his education while employed part-time at Hughes Aircraft Company in Culver City, California.

Ernandes is a member of Eta Kappa Nu. He won a Frank Memorial scholarship and a John McMullen scholarship.

Ward B. Browning, Jr., BSinEE '44, (below) 151 Greenhill Drive, Butler, Pa., has been named assistant works engineer, development and construction, at the Butler Works of Armco Steel Corp. He joined Armco in 1946 and served as an engineering draftsman until 1951 when he was made senior electrical engineer. In 1956, he became projects engineer of the Butler Works construction program.

Ward B. Browning, Jr.

CAN YOU FIGURE IT OUT?

Re-arrange the numbers 1 to 49 so that all rows, horizontal and vertical, and the two major diagonals, add up to 175 each. It can be done!

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	32	33	34	35
36	37	38	39	40	41	42
43	44	45	46	47	48	49

✻ Solution at bottom of page

Lee Baker tells what it's like to be . . . and why he likes being . . . a Manufacturing Engineer with IBM.

FIGURING OUT A CAREER?

Selecting a career can be puzzling, too. Here's how Lee Baker found the solution to *his* career problem—with IBM:

Despite his impending Service hitch, Lee was hired by IBM in 1953. As a Technical Engineer, he entered the General Manufacturing Education Program, a 10-month course with rotating assignments in all phases of the work: manufacturing, purchasing, production. Then came two years in Korea. Now back at IBM, Lee has been promoted to Production Control Engineer, responsible for designing systems to insure a smooth flow of work through the IBM electronic computer plant. "It takes *creative* engineering ability to design these systems," says Lee, "and *administrative* ability to 'sell' a system to higher management."

• • • •

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30	39	48	1	10	19	28
38	47	7	9	18	27	29
46	6	8	17	26	35	37
5	14	16	25	34	36	45
13	15	24	33	42	44	4
21	23	32	41	43	3	12
22	31	40	49	2	11	20

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COLLEGE NEWS

ENG COLLEGE SPONSORS TUTORING SERVICE FOR FRESHMAN ENGINEERS

Cornell University's College of Engineering has adopted a comprehensive new tutoring program designed to aid engineering freshmen change pace from the secondary school curriculum to the more rigorous teaching and more exacting study requirements of the college program.

S. C. Hollister, dean of the college, has announced that 52 tutors have been selected from outstanding fourth and fifth year students in the College of Engineering. All of the more than 600 engineering freshmen will have the opportunity to meet with tutors as they begin their college programs. There will be special emphasis in two subjects, mathematics and physics. Dean Hollister pointed out that students enrolled in colleges other than engineering who are taking these subjects may also avail themselves of the tutoring service.

The program is sponsored by the College of Engineering and the Departments of Mathematics and Physics of the College of Arts and Sciences. Tutors will be under the supervision of Prof. C. L. Cornell of Electrical Engineering, W. B. Carver, Professor Emeritus of Mathematics, and Guy E. Grantham, Professor Emeritus of Physics. The program is financed as a special project by a grant from an anonymous engineering alumnus.

Under the program there will be two senior engineering student tutors on duty in each university dormitory occupied by engineering freshmen from 7:30 to 11 p.m. on Sunday through Thursday evenings during the fall semester. Tutors' rooms are on the first and third floors of each of the six University Halls. A tutor will also be assigned to aid women students enrolled in mathematics and physics. The service is available to any freshman taking courses in either or both of the subjects.

According to Dean Hollister, the new plan does not duplicate nor supplant the present student counseling service in dormitories nor the faculty advisor system.

"The program will help freshmen to acquire sound study habits and to make an easier adjustment from the accustomed secondary school pattern to the more rigorous and demanding college course," Dean Hollister said. "It should help to insure the academic success of a number of students whom the college and the country can ill afford to lose."

Dean Hollister pointed out that Cornell engineering freshmen are among the highest ranking students, academically, to be admitted to the University, and that their problems are not those of ability to learn, but rather they are problems of connecting their high school preparation to the accelerated pace of University study requirements.

The following upperclassmen have been selected as tutors: Donald Armstrong, Joel Bergman, Saul Blumenthal, Donald Brierley, Donald Buzzelli, Mrs. Marilyn Chesler, James Comly, Walter Curtis, Harvey Fein, Julius Feinleib, Gerald Friedman, Jeffrey Germain, Guido Henry, Richard Hilbrecht, Robert Hinman, John Ingley, Keith Kleckner, David Koppes, Curran Kraft, William Krell, John La Tour, Jr., Donald Leonard, Larry Lutsky, Gleason Lytle, Georges London, Donald Malone, Bruce Marcus, Jay Markley, Phillip Marriott, James McNally, Karl Menger, Peter Mengert, Rudolph Metznor, Michael Miller, Jr., Richard W. Powell, Robert Reinhardt, Martin Sahn, Ronald Schroeder, Alan Seeley, Gerald Seidel, Robert Seidel, Robert Steele, Donald Steinberg, Howard Stevenson, Jr., Howard Stoddard, James Tarbell, James Thorp, Roger Trenbath, John Tretbar, Robert Turner, James Whalen, Walter Whitman, John Wolberg, and Morton Yagel.

CHEMICAL ENGINEERING CURRICULUM CHANGED

The School of Chemical Engineering has recently announced a change in its curriculum. The program change has its most pronounced affect upon first and second term scheduling by reducing the number of credit hours from seventeen to fifteen.

This change was instituted because of modern trends in chemical industries. Present tendencies seem to indicate a diminishing need for rigorous training in laboratory procedure. Following this policy, the School of Chemical Engineering has eliminated two three-credit inorganic chemistry courses which required a total of nine class hours per week. These courses have been replaced by a single four-credit inorganic chemistry course requiring fewer class and laboratory hours over a period of two terms.

The laboratory work that has been omitted will bring the program more in line with present industrial requirements. It is felt, however, that the instruction in chemical theory which will have to be temporarily eliminated ought to be covered during some later term.

While helping to meet modern curriculum needs, the change will also ease the freshman chemical engineer's schedule to some degree. In order to further facilitate his adjustment to chemical engineering, a weekly freshman orientation lecture is given.

ENGINEERS GRADUATES OFFERED HIGH SALARIES

Engineering graduates from Cornell in June were given hundreds of job interviews and received starting salaries as high as $7200 a year. Two hundred six companies interviewed two hundred sixty-two graduates. They held one amazing total of 2363 interviews, or almost nine per graduate.

EP's and ChemE's were the most [illegible] called for, each group having an average of between ten and eleven interviews. All groups averaged at least five contacts, with the EP's and MetE's averaging between five and six.

Starting salaries reflect the present shortage of technically-trained men, as the lowest offer accepted

was almost $5000 a year. For the one hundred twenty-one seniors accepting positions in industry, the average pay was $493 per month, or over $5900 a year. Chemical Engineers drew the highest offers, averaging $516 a month. CE's had the lowest average, $469 a month, while the others ranged from $485 to $505. The highest salary, $608 a month, was offered to an ME, as was the lowest salary, $390.

Of the students not going to work in industry, the EP's had the largest percentage going on to do graduate work, 55% (11 out of 20). Only five ME's out of a class of seventy-five went on to graduate school, this being the lowest percentage. In all, out of the group of 1184 graduates who reported back to the university, 121 accepted positions in industry, 30 went into military service, and 33 are continuing their studies in graduate school.

ELECTRICAL ENGINEERS ANALYZE TRANSMISSION SYSTEM

Electrical engineers from the Central Hudson Gas and Electric Company, Poughkeepsie, are engaged in a two-week analysis of their transmission system at Cornell's School of Electrical Engineering.

Using the Cornell A-C Network Calculator, the engineers reproduce in miniature the transmission system of the area covered by their company, study the load distribution, and plan for expanding service.

Fred P. Jones, of Central Hudson's Planning Division, is in charge of the current research session, assisted by P. J. Hamill and Arnold Mastromonico of Poughkeepsie.

This computing facility, under the supervision of Professor Simpson Linke, has been in operation at Cornell for two years. Research Associate Lawrence B. Spencer, Cornell Class of 1934, directs all operations of the installation. D. W. Pulleyn is Assistant Operator.

ARCHITECT STUDENTS ERECT HUGE PINE CONE DESIGNED BY FULLER

A "pinecone," 40 feet in diameter, now stands on the Cornell campus, the effort of a group of architecture students directed by architect-designer Buckminster Fuller.

The structure is made of four-by-eight foot plywood sheets, and gets its pinecone appearance from additional "tails," four-by-eight sheets screwed onto the basic boards to provide strength and weatherproofing.

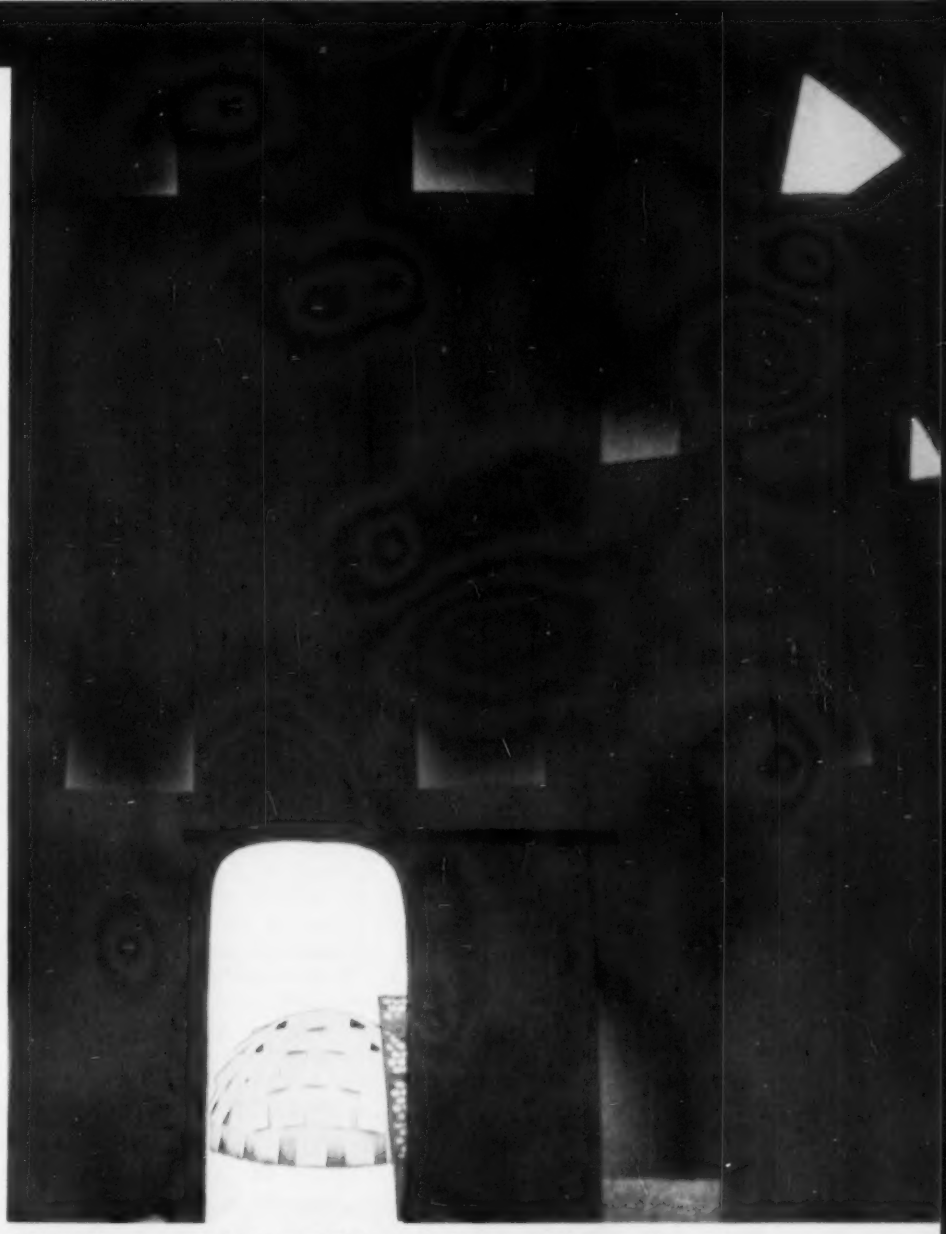
The dome, five-eighths of a sphere, can stay as is, weatherproofed with aluminum paint, or can be used as a scaffoldless frame for a concrete dome.

It cost $1,500 in materials and 750 hours of unskilled student labor. Fuller estimates that, while scaffolding and framework for a concrete dome usually cost $4.50 per square foot of floor area, this method would cost only $1.50 a foot, and the framework would not have to be removed.

The plywood units were prepared ahead in a shop—holes bored with hand electric drills, painted with aluminum paint of spar varnish and powdered metal, and joined with the tails.

At the site, sheets were screwed together from the top down, beginning at a central pentagon-shaped opening at the top and working down to a circular plywood base that is a mounting for the structure.

The Cornell Structure is another example of Fuller's "synergetic" geometry and dymaxion principle of getting maximum space per man-hour of labor, pound of material and dollar of cost.



Inside looking out at Buckminster Fuller's synergetic geometric dymaxic dome. It provides maximum space per man hour of labor and pound of material.

ENGINEERING QUAD PROGRESSES

Another step has been made toward the completion of Cornell's new Engineering Quadrangle with beginning of construction on the civil engineering building this September. Representing a $2,000,000 gift from Spencer T. Olin '21, the building is expected to be completed by the spring semester of 1959.

While power shovels were breaking ground for this project, the moving of the College of Engineering's library and administrative offices to the newly finished Carpenter Hall was being completed. This building, a $1,000,000 gift of Walter S. Carpenter '10, will be dedicated November 1 by Mr. Carpenter.

Meanwhile, diagonally across the Quadrangle from Carpenter Hall, construction nears completion on Upson Hall. This hall, a gift of Maxwell Upson '99, will house the College of Mechanical Engineering when completed next spring.

Completing the Quad, will be the $500,000 aeronautical engineering building. Construction of this building, which will adjoin the southeast corner of Upson Hall, is expected to begin in the near future.

UPSON GUIDES BUILDING DEVELOPMENT PROGRAM

Maxwell M. Upson, chairman of the board of the Raymond Concrete Pile Company of New York, a Mechanical Engineering graduate in 1899, and donor of Upson Hall of Mechanical Engineering in 1956, has been named chairman of a new Engineering Development Committee, organized to guide the Cornell College of Engineering building and development program to completion.

Mr. Upson will head a committee which will launch a campaign, this month, to raise $1,500,000 among the College's 19,000 alumni, to provide for the necessary facilities, landscaping, equipment, etc. which will complete the new Engineering quadrangle.

Buildings already built or provided for represent a total cost of $14,000,000, and the new campaign, guided by a group of prominent alumni of the college, will bring the overall total to $15,500,000.

Among the facilities sought in the new drive will be the first floor of a metallurgical engineering building, apparatus and equipment for new and existing buildings, housing for a new nuclear reactor for teaching purposes, and landscaping for the entire quadrangle.

S. C. Hollister, Dean of the College of Engineering, and John F. McManus, Assistant Dean, discuss completion plans for the engineering campus in the Dean's new office in Carpenter Hall.

HONOR STUDENTS ANNOUNCED

Students on the Engineering Dean's Honor List have maintained an average of eighty-five or better for the entire preceding academic year. The following Chemical, Metallurgical, Electrical and Agricultural Engineers have been placed on the Dean's List for the 1956-57 year. This list does not include summer co-op students. Their names will be published in the next issue of the ENGINEER.

Chemical and Metallurgical Engineers

Samuel W. Bodman III
Philip J. Bowers Jr.
William T. Dixon Jr.
William R. Foltin
Harry L. Fuller
Charles A. Gray
Edward L. Hoffman Jr.
William J. Krossner Jr.
Roy J. Lamm
Peter Nicoletopoulos
Jimmie D. Patton
Edward J. Quirk
Charles S. Revelle
George W. Roberts
Laurence R. Steenberg
Max C. Deibert
Chester R. Fox
Bartley R. Frueh
Allen P. Miller
Edward H. Zander
Brinton S. Deighton Jr.
Henry G. Kammerer
Donald A. Leonard
Jay L. Markley
Donald H. Steinberg
Roger K. Fisher
Morton Friedman
David S. Lermond
John E. Lind Jr.
George L. Mueller Jr.
Mrs. Lavonne Olson Tarleton
Martin H. Wohl

Electrical Engineers

Frank W. Ballou
George E. Beine
Joel Bergsman
David A. Berkley
Richard A. Brockelman
John E. Burget
Gerald A. Chayt
Thomas H. E. Cottrell
Paul H. DeGroat
Kenneth W. Dodge
Raoul E. Drapeau
Richard F. Fellows

(Continued on Page 84)

Summer Conference

Engineering Education

The American Society for Engineering Education held its sixty-fifth annual meeting at Cornell last summer. The meeting provided an opportunity for members to hear numerous papers read and discussed and offered leading educators chance to resolve some of their teaching problems.

Cornell was host to the society on three other occasions since its founding in 1893. Conferences were held here in 1923, 1926, and 1934. Of the Society's 7,500 members, sixty are Cornellians.

The interests of the members are focused in 22 divisions. These divisions include such fields as civil engineering, mechanical engineering, educational methods, English, humanities, and industrial relations with technical institutes.

The program ranged from the election of new officers and the presentation of awards to the reading of technical papers and seminars on all phases of engineering and engineering education. One of these papers criticized many engineering teachers for not creating an atmosphere in which thinking can take place.

Dr. Robert A. Janke, author of the prize winning dissertation, stated that too much emphasis is placed on factual material. Such emphasis does not leave enough time to reflect upon the material or the manner in which it is interrelated.

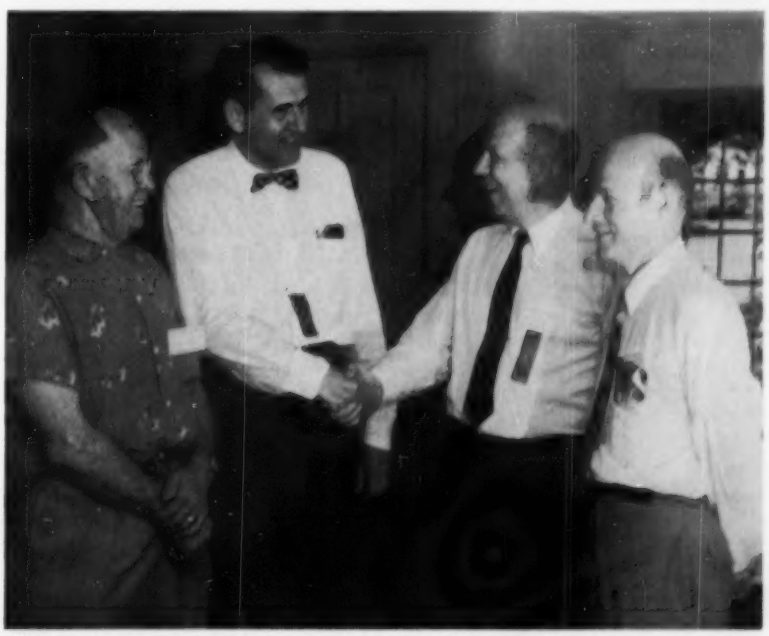
Dr. Janke suggested that engineering instructors take the time to demonstrate proper study methods to their students. He said that examples and practical applications should be used only to focus upon fundamental principles and that textbooks should serve as guides to learning rather than sources of reference facts. The author also suggested that we do away with any ideas about mass production engineering education (such as closed circuit television) for it cannot effectively replace the interchange of ideas which goes on in small classes.

Dr. Janke's pet peeve is the "cook book" laboratory experiments used in many courses. He felt that this type of laboratory discourages the student from doing his own thinking.

Another paper was presented dealing with the integration of subject matter, particularly mathematics, physics, and mechanics. The paper outlines the educational system used at Brown. By a careful reorganization of its courses to omit needless repetition, Brown manages to include all of the usual engineering courses in eight terms with only four courses per term.

Freshman physics is omitted since the subject matter is covered in mechanics and calculus. Mathematics courses are not required after three terms because the study of differential equations is continued through mechanics of materials and electrical circuit courses. Despite the radical nature of these changes, Brown has met with considerable success by constantly re-evaluating each course.

A speaker from the Navy Department discussed the integration of school and industry. He stated that co-op students were better prepared for industry than their non co-op classmates. He pointed not only to the shortage of engineers, but to the shortage of engineers in



Former ASEE president W. L. Everitt (Illinois) congratulates the new president, Fred Lindvall (CIT), and the new vice presidents, Carl Eckel (Colo.) and Glenn Murphy (Iowa State). From left to right: Eckel, Lindvall, Everitt, Murphy.

supervisory capacities. The speaker felt that co-op students were the natural candidates to fill these positions since they have been exposed to industrial problems.

The ASEE had also been concerned with the attraction of engineers into teaching. A study of the recognitions and incentives offered teachers showed that some teachers lack the prestige which is due them. The Society made some recommendations to make teaching more attractive. It suggested that each college try to promote the dignity and prestige of its faculty and that the difference in pay between schools and industry be eliminated. The ASEE felt that committees should be alerted to the needs of the staff and that these committees should make recommendations to increase the staff's prestige and morale. A final suggestion was that awards be presented to members of the faculty for distinguished service to teaching.

In conjunction with the teacher shortage, a paper was presented by a teacher at the Air Force Institute of Technology dealing with the Institute's program of activities for young instructors. The program has a threefold objective. It serves as an orientation for new engineering teachers; it provides a place for the young instructors to go to seek advice and to discuss teaching problems; and it provides an informal atmosphere in which young instructors can become better acquainted. This program had met with considerable success, and it has undoubtedly influenced many young engineering educators to remain in the teaching profession.

In his presidential address, W. L. Everitt cited eight problems that demand immediate attention from the Society. Studies being made in these areas range from the proper guidance of high school students to the integration of students between technical institutes and colleges. These problems will be studied throughout the year, and many of them will be discussed at next year's conference to be held at the University of California (Berkeley) under the tutelage of the Society's new president, Fred Lindvall from the California Institute of Technology.

by Peter M. Sacerdote

COLLEGE NEWS

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Karl A. Foster
James B. Fraser
Jeffrey I. Frey
Robert S. Gale
Lewis M. Holmes
Jay C. H. Hsu
William J. Hudson Jr.
Keith R. Kleckner
Arthur R. Kraemer
John LaTour Jr.
Robert J. Loane
Herschel H. Loomis
Lee A. Mackenzie
Donald M. Malone
Stephen J. Marmaroff
Karl S. Menger
Wiwat Mungkandi
Michael L. Ossar
Thomas W. Parks
Martin P. Pope
William Quackenbush
Gerald E. Sacks
David Sargent
John G. Simek
David P. Snyder
Charles W. Stewart
Howard H. Stoddard
Enn Tammaru
Roger G. Thomas
Robert C. Waag
Richard Weiss
James J. Whalen
William M. Wichman

Agricultural Engineer

Robert Barclay Beahm

PROFESSOR APPOINTMENTS MADE IN CE, ME SCHOOLS

Cornell announces the appointment of three associate professors in its College of Engineering: Dr. Ta Liang in civil engineering, and Dr. Hugh N. Powell and Dr. Lionel Weiss in mechanical engineering.

Dr. Ta Liang received his master's and doctor's degrees at Cornell and from 1951-54 he worked with D. J. Belcher and Associates, aerial photography analysts. He returns now from an engineering position with the firm of Knappen, Tippets, Abbett and McCarthy in New York City.

An authority in aerial photography and soil mechanics, Dr. Liang is a contributor to "Landslides and Engineering Practice," published by the National Research Council, and co-author of a six-volume "Key to Aerial Photographic Determination of Ground Condition, Landform Series," published by the Office of Naval Research. His bachelor's degree is from Tsing-Hua University in Peiping, China.

Dr. Powell, since 1951, has done fundamental research in thermodynamics, combustion and gas dynamics with the basic combustion unit of General Electric, in Cincinnati, Ohio.

He is a native of Birmingham, Ala., and a graduate of Georgia Institute of Technology. His Ph.D. is from the University of Delaware.

Dr. Weiss has been on the mathematics faculty at the University of Oregon for the past year, and before that spent seven years teaching statistics at the University of Michigan.

He was a visiting assistant professor of mathematics at Cornell in 1952-53 and has returned this year to offer some courses in mathematics, operations research and applied statistics in the industrial engineering department of Sibley School of Mechanical Engineering.

He received BA and MA degrees in economics and a PhD in statistics at Columbia University.

METALLURGICAL SOCIETY MEETS

A reactivated Cornell Metallurgical Society is holding monthly meetings on Friday evenings in Olin Hall. Freshmen, who usually don't encounter metallurgical problems until they are upperclassmen, will be introduced to their future work by lectures, films and informal discussions. Richard Goodspeed, the secretary, said, "We want the Society to be a cohesive unit of the Metallurgical School, where both freshmen and upperclassmen can gather socially and exchange ideas on metallurgy."

On October 11, Glen Tuffnell, president, presided over the first meeting of the term. "Woody" Woodcock, from the Ithaca Gun Factory gave an amusing talk on metallurgical failures in gun barrels. Beer and other refreshments were served in a social hour that followed the talk.

(Continued on Page 87)

TECHNIBRIEFS

ELECTRICITY FROM NEW CHEMICAL PROCESS

The direct conversion of the chemical energy of gases into electricity—long a dream of scientists and for years a laboratory curiosity—is now an accomplished fact with the development of the first fuel cell capable of economically producing thousands of watts of power. Hydrogen and oxygen are the two fuels used.

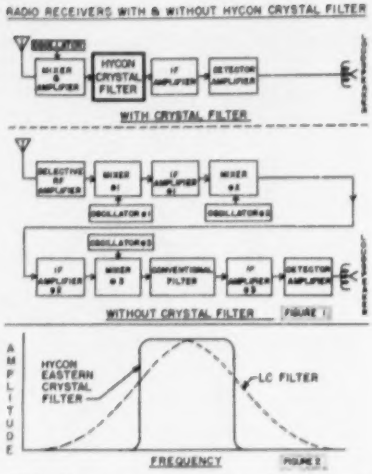
The first application of this new fuel cell is in providing silent electricity for the army's new "Silent Sentry." This is the world's smallest radar set and is capable of providing information irregardless of smoke, darkness or fog. The secret of the new fuel cell's success, experts say, is the chemically treated, hollow, porous, carbon electrodes, through which the gases enter the cell, and which also conduct the electricity produced by the electrochemical reaction.

The new cell is designed to work at ambient temperatures and at atmospheric pressure thereby being the first that does not depend on high temperature or pressures for efficient operation. The efficiency of this device is about 75% as compared to 35% for a steam engine. Another distinct advantage of this cell is the fact that the chemical constituents of the cell remain relatively unchanged during the course of their use while other batteries like a flashlight produce electricity by the consumption of the chemical elements that compose it.

This fuel cell provides a practical efficient means for converting hydrogen and oxygen gas and electricity.

This new cell is merely a sealed jar into which are fed hydrogen and oxygen through the special hollow electrodes. The electrochemical reaction of the gases at these electrodes produces an electric current, with only water as a by-product. With the water disposed of by evaporation the life of the cell is theoretically unlimited. The fact that the cell can operate at normal atmospheric pressure does away with the large costs needed for machinery to produce high pressures.

The new design is unique in that the cell can operate with hydrogen containing considerable impurities. This means that standard industrial grades of commercial purity can be used. Present design calls for the grouping of a number of specially catalyzed, hollow, porous carbon electrodes in a sealed cell containing a solution of potassium hydroxide as the electrolyte. Hydrogen and oxygen enter the cell through the hollow electrodes, and diffuse through the porous carbon to the surface, where they come in contact with the electrolyte. At the hydrogen electrode, the electrochemical reaction with the potassium hydroxide produces water and releases an electron that enters the electrical circuit. The electron flows through the external circuits and returns to the cell at the oxygen electrode, where in the electrochemical reaction of the oxygen and the electrolyte, the electron is accepted. Ionic conductivity through the electrolyte completes the electrical circuit. The inherent advantages of the fuel cell make it an ideal source of silent electrical power in remote locations where conventional fuels or water power are not available.



This diagram shows the simplification of equipment requirements using the quartz crystal filter.

HIGH FREQUENCY CRYSTAL BOON TO RADIO AND RADAR

A new type of radio and radar component, a high frequency crystal, makes it possible for more radio stations to transmit without overlapping and interfering with each other. The new device is a great space saver and can be compared to the conventional filters as transistors are compared to vacuum tubes. With the ever increasing amount of radio communication messages crowding the air waves, the allotment of frequency bands has become a problem. The difficulty of designing a workable filter increases as one goes higher in frequency. Now that this new type of filter is available, commercial and military sources have made plans for new devices utilizing this device.

Constant servicing, particularly tuning and alignment, has been one of the major problems with radio receivers. With crystal filters a radio receiver does not normally have to be aligned after it is manufactured. These quartz crystals are very stable under severe environmental conditions and can stand abrupt temperature changes and repeated heavy shock and vibration. Radio and radar receivers will now have fewer parts, since mul-

tiple conversion, a device for getting around certain filtering problems, is unnecessary with the new device. Many uses of the new reliable crystal filter will be in the field of mobile communications such as military vehicular radios, walkie talkies, & radios. Still more varied applications are also foreseen. A tiny button microphone worn in the label may be developed with a capacity to transmit messages or speeches several hundred yards without any connecting power sources. Electronic specialists hail this low cost filter as one of the more important technological advances of this decade.

RADIOISOTOPE CAPSULES SEALED BY REMOTE CONTROL

A new welding unit has been developed and is in use at Oak Ridge. The unit is remotely operated and uses an inert gas shielded arc welding torch. The welding equipment consists of two portable units; a power supply unit and a remotely-operated assembly. The power supply unit is of conventional design and includes a welding machine, control panel and motorized amperage control. The remotely-operated portion of the welding device, which is placed in a shielded cell equipped with mechanical manipulators, consists of a two-piece stainless steel frame and motor-driven positioners for both the torch and containers. The main use will be in sealing large sources of radioactive materials. These large sources will be used in medical and industrial application. Also radioactive material that has no present use can be saved for possible future use.

SPACE FLIGHT SIMULATED BY GLOBAL PROJECTOR

An army engineer has developed a new device for simulating the actual flight of a space vehicle. Called "Pantrack," it projects a moving view of the terrain over which the vehicle "flies," showing the area as it would be seen by an observer in a space ship or satellite. The apparatus consists essentially of a projector inside a globe, which may be positioned manually or automatically to show on a screen or wall any portion of the earth's surface either at rest or in motion. This device can be used to track a satellite through the use of signals transmitted from the moving object controlling the drive motors of "Pantrack." It is expected that this device will be used to stimulate public interest in space travel.

A technician is using a high temperature microscope to study material in the arc image furnace.

COLLEGE NEWS

(Continued from Page 84)

DIRECTOR WINDING ADDRESSES A. I. CHEM. E.

Professor Winding delivered his first talk as the new director of the School of Chemical and Metallurgical Engineering before the members of the American Institute of Chemical Engineers at their meeting on October 11 in Olin Hall. Professor Winding, who succeeds Professor Emeritus Fred H. Rhodes in the top post in the school, recalled the history of chemical engineering at Cornell and compared the school's present policies and curriculum to those at other chemical engineering colleges.

AIChemE president, Michael Midler Jr., announced plans for the society's next speaker, Mr. G. L. Andrews, plant manager of Procter and Gamble. He will speak about the "Chemical Engineer in Management" at the November 8 meeting to be held in Olin Hall.

ONE-HALF OF ENG STUDENTS RECEIVED FINANCIAL AID

Almost one-half of the students enrolled in the College of Engineering received some form of financial aid for the year ending June 1957, according to a scholarship report issued by Mr. Donald H. Moyer, director of the Office of Student Personnel in the College of Engineering. One student in four received aid directly from the College; one in three was helped by University funds; and 813 won some form of scholarship aid, including awards made by the State, the alumni and various industries and foundations. Eighty more students, enrolled in the Regular NROTC program brought the total of students receiving financial grants to nearly 50%.

Scholarship expenditures by the College increased 4½% during 1956-57 to an alltime high of $302,729.46. Since the scholarship stipends for engineering students from all sources amounted to $455,366.96, scholarships awarded by the Office of Student Personnel accounted for two-thirds of the total.

The report noted that there was a significant realignment last year in the pattern of scholarship awards.

(Continued on Page 93)

CAREERS WITH BECHTEL

PORTER THOMPSON, *Assistant Chief Engineer, Refinery Division*

MECHANICAL ENGINEERING

One of a series of interviews in which Bechtel Corporation executives discuss career opportunities for college men.

QUESTION: *Mr. Thompson, some engineering graduates seem to believe their first jobs might include little more than filing papers. Would that be true at Bechtel?*

THOMPSON: It would not. When the young man joins the Refinery Division, if he is a structural engineer he starts immediately to do structural design work, under proper supervision. An electrical engineer would join our electrical group, working on electrical systems for refineries, doing some design work, taking off materials and working on instrumentation.

QUESTION: *What about mechanical engineers?*

THOMPSON: Mechanical and chemical engineers may either go right into the process department, where they would do calculations, or into the project group where they would do routine designing and write specifications for pumps, exchangers, vessels, piping, instrumentation, insulation, etc.

QUESTION: *There's certainly no sign of "paper shuffling," is there?*

THOMPSON: No. The training period is interesting right from the start. After a few months, we like to send the young engineer out into the field so he can see the end result of what he has been doing.

QUESTION: *What has been your experience as to the length of time required to train a man?*

THOMPSON: That will vary according to the man, so it's impossible to generalize. The young man will have some responsibility right from the start, but it may well be a matter of several years before he can actually take full responsibility for running a job.

QUESTION: *Assuming he handles his first assignments satisfactorily, what would be his first major step upward?*

THOMPSON: After from 6 to 9 months his first responsible assignment might be on a project in connection with handling pumps. On his next project assignment he might have the responsibility for handling pumps and exchangers. He would likely be assigned some other responsibility on each succeeding project. In that way he would get a good grasp of all types of work and eventually be capable of taking overall charge of a project.

QUESTION: *Suppose he is in the structural phase; would there be any difference in his "basic training"?*

THOMPSON: No. He would still have to serve his apprenticeship, moving gradually into more and more complex design work as he gains, a little at a time, the knowledge and experience which qualify him to handle the overall job.

Bechtel Corporation (and its Bechtel foreign subsidiaries) designs, engineers and constructs petroleum refineries, petrochemical and chemical plants; thermal, hydro and nuclear electric generating plants; pipelines for oil and natural gas transmission. Its large and diversified engineering organization offers opportunities for careers in many branches and specialties of engineering —Mechanical...Electrical...Structural ...Chemical...Hydraulic.

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Vice President, Industrial Relations
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How does a chemist happen?

"New ideas," Henry Thoreau wrote, "come into the world . . . with a flash and an explosion and perhaps somebody's castle roof perforated." Many a budding young chemist has introduced his parents to chemistry in similar fashion. But the real making of a chemist takes place in quiet, unspectacular little ways.

There is the challenge of a teacher who asks two new questions for every one he answers.

There is the mental sweat and labor of working out a quantitative analysis—and the glowing pride of being *right*, to the fourth decimal place.

There is the romance of chemistry written wordlessly in the twinkle of an aging professor's eye.

There is memorizing and mixing . . . calculating and titrating and cramming. Hour upon unending hour of them.

But the hours, the days, the years of work and study silently dissolve in that magic moment when a new idea strikes . . . in that moment when all that *has* been done is forgotten, when all that seems important is to learn if this new thing that has never been done, *can* be done.

In that fleeting moment, the student becomes a scientist and begins for the first time to use chemistry to help people gain a little more comfort, a little extra convenience, a little better health.

It is many such moments that make a career in the chemical industry exciting, challenging, and very, very satisfying. Write for a copy of our booklet which shows how you can achieve this type of satisfaction at Koppers. Koppers Company, Inc., Pittsburgh 19, Pennsylvania.

KOPPERS

KOPPERS CHEMICALS

LOOK WHO'S IN THE DRIVER'S SEAT...

...but are you really?

and equally important, are you going to get somewhere?

Perhaps you have heard some classmate say, almost complacently, "Times have changed."

With many branches of industry today openly competing for good science and engineering graduates, who can blame the young graduate-to-be for feeling supremely confident. You know you can get a job, know that salaries are high and are fully aware that men with technical backgrounds are moving up to administrative positions in ever-increasing numbers.

Nevertheless, in many respects, times have not changed at all. That "first job" is every bit as important today as it was five, ten, twenty years ago. Starting salaries remain only one of many factors to be considered. And a man's future is still necessarily linked to the future of the company for which he works. Moreover, a thoughtful examination of such matters as potential growth, challenge, advancement policy, facilities, degree of self-direction, permanence, benefits and the like often indicates that real opportunity *still* does not grow on trees.

For factual and detailed information about careers with the world's pioneer helicopter manufacturer, write Mr. Richard L. Auten, Personnel Department.

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One of the Divisions of United Aircraft Corporation

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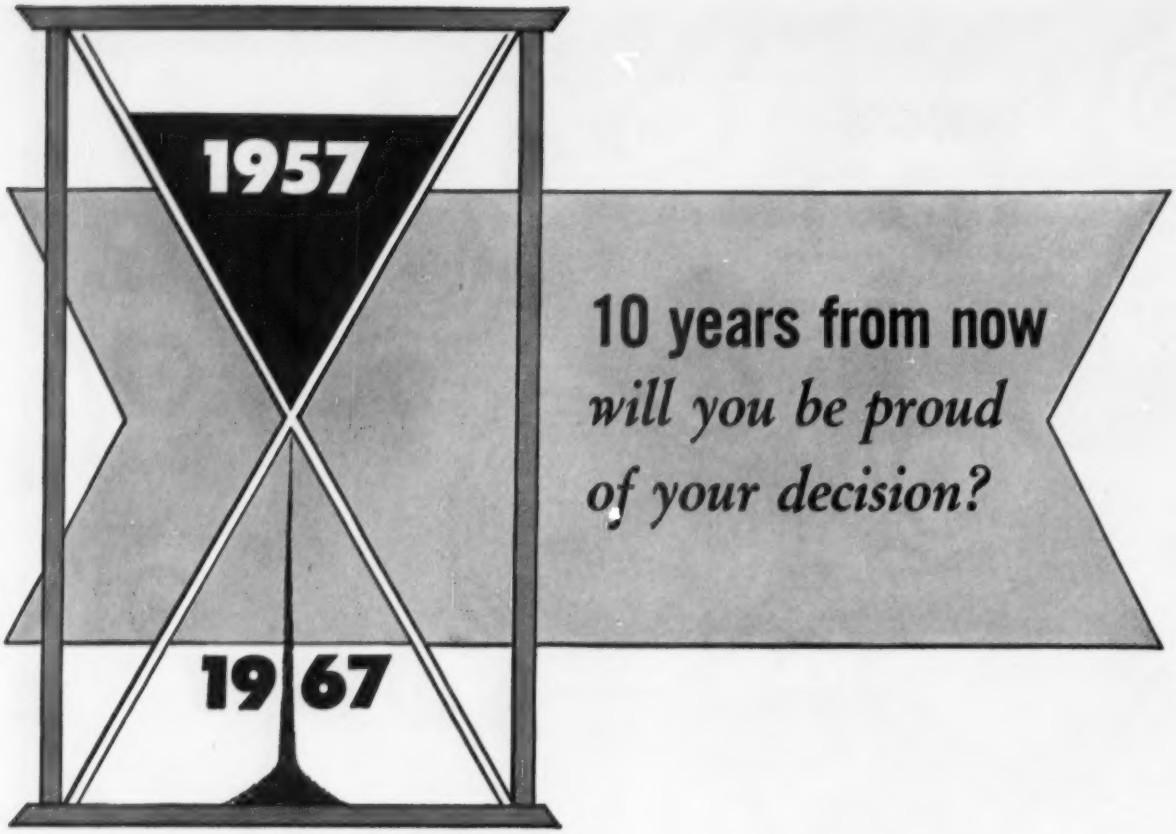

The right decision now, at the launching of your career, can do much to influence your success.

Pittsburgh Plate Glass Company has a host of fine young men who are holding responsible positions in the PPG organization. Ten years ago, many of them were faced with the same decision that now faces you: "Which company shall I select?"

They chose PPG because it offers unlimited opportunity. PPG has never stopped expanding or growing in its 73 years of existence. Its markets are constantly increasing. PPG's management is progressive. It seeks men who can grow with the company . . . men who can take over responsibilities. In PPG, it isn't necessary to wait for a man's retirement or death before you move up in the ranks. Opportunities are opening up all the time in all of its important divisions: Paint, Glass, Chemicals, Brushes, Fiber Glass.

This is your year of decision. We invite you to look into Pittsburgh Plate Glass Company. To help you become better acquainted with PPG, we suggest you get a copy right away of the booklet entitled, "Toward New Horizons with Pittsburgh Plate." Ask your placement officer for a copy or write directly to the Pittsburgh Plate Glass Company, General Personnel Director, One Gateway Center, Pittsburgh 22, Pennsylvania.

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34S PLANTS, MERCHANDISING BRANCHES, AND SALES OFFICES LOCATED IN 250 CITIES

COLLEGE NEWS

(Continued from Page 87)

Expenditures for undergraduates from the John McMullen Fund dropped by nearly $25,000, and those by other University agencies by nearly $20,000. These decreases were more than offset, however, by an increase of 63% in industrial and foundation awards, and 24% greater expenditures from other endowment funds in the College.

During the year the current philosophy of making scholarship awards was questioned. The point was made that it would be desirable to reward scholastic excellence with higher stipends rather than to base all stipends on need. The report stated that "there is much to recommend this view but it is very difficult, if not impossible, to reconcile such procedure with the practice now prevailing of basing stipends on need. In some Schools of the College, industrial scholarships have been solicited where need has been only a minor factor and these awards have been made to outstanding upperclassmen as prizes. Until such time as a return to the 'monetary incentive' philosophy of scholarship awards is possible, a few such 'Prize' awards made annually to upperclassmen might take the edge off the question."

STUDENTS WIN AWARDS FROM WELDING FOUNDATION

Donald B. Malcolm, a student in the Machine Design Department of the Sibley School of Mechanical Engineering, won the Third Grand Award in the annual competition sponsored by The James F. Lincoln Arc Welding Foundation of Cleveland. He designed a machine to handle work for automatic welding. The Lincoln Foundation awarded him $500 and the Machine Design Department was presented with a $250 scholarship to be known as the Donald Barkley Malcolm-Lincoln Foundation Scholarship.

Four civil engineers at Cornell working together won a Fourth Award in the Structural Awards class valued at $75. They are: Sam Codella, Donald Crotty, Jerome Quinn and John Rawlins. They submitted a paper entitled, "Structural Framework for a Suspended Monorail Rapid Transit System."

The Lincoln Foundation is sponsoring a similar competition for the current school year to again interest undergraduate engineers in studying how welded design can reduce costs and improve both machines and structures of all types. Any resident undergraduate can participate.

AMERICA'S EARTH SATELLITE DISCUSSED

Dr. Charles F. Green, an authority on rocket development, addressed a joint meeting of the Ithaca section of the American Institute of Electrical Engineers and the Ithaca section of the Institute of Radio Engineers at 8:00 p.m. Friday (October 4) in Room 101 of Phillips Hall.

Dr. Green discussed "Our Approach to the Earth Satellite." He is visiting professor of electrical engineering at Cornell and manager of advanced development, Aeronautic and Ordnance Systems Division of the General Electric Advanced Electronics Center in Ithaca.

A member of the Upper Atmosphere Research Panel since 1946, Dr. Green is the author of a book, "Rocket Exploration of the Upper Atmosphere." He has also published numerous articles concerned with radio aids to air navigation and rocket development. He has been associated with General Electric for more than 25 years.

Members of AIEE and IRE inspected the Microwave Astronomy Laboratory in the afternoon and met for dinner at 6:30 p.m. in the Kimball Dining Room at Willard Straight Hall.

C.A.L. SUPPORTED PROFESSORSHIPS INCREASED

Cornell Aeronautical Laboratory, Inc. announced that it has increased the number of Laboratory supported professorships at Cornell University.

The Laboratory has supported one professorship each year for the past four years. This year, CAL's Board of Directors authorized the support of a second professorship for the coming school year. Plans also were made for the addition of a third for the following year.

Professor Mark Kac of the University's Mathematics Dept. and Prof. Henry McGaughan of the Electrical Engineering Dept. were named to fill the positions for the coming year. Prof. Kac held the one CAL chair in 1956.

In return for the Laboratory's support, both professors will conduct courses, on a once-a-week basis at the Laboratory for CAL employees. University credit may be obtained by those who successfully complete the courses.

The third professorship will be filled by a Cornell University faculty member who is expected to take up full time residence at the Laboratory.

UNIVERSITY ESTABLISHES ME PROFESSORSHIP

A $500,000 bequest to Cornell University by the widow of a 1911 Cornell mechanical engineering graduate will enable the University to establish a distinguished professorship in mechanical engineering. The bequest, made for the specific establishment of the Joseph C. Ford Professorship, has been made by Mrs. Vera V. Ford of Madison, Wisconsin, who died at Madison on March 3, 1957.

Mr. Ford, who received his mechanical engineering degree at Cornell in 1911, was founder and president of the Celon Company from 1926 until his death on October 20, 1956.

According to terms of Mrs. Ford's will, admitted to probate at Madison on April 9, the bequest to Cornell University shall be used to establish "a distinguished professorship" in mechanical engineering. The intent, according to the will, is to provide for the initial salary and for salary increases which may become essential to maintain the professorship.

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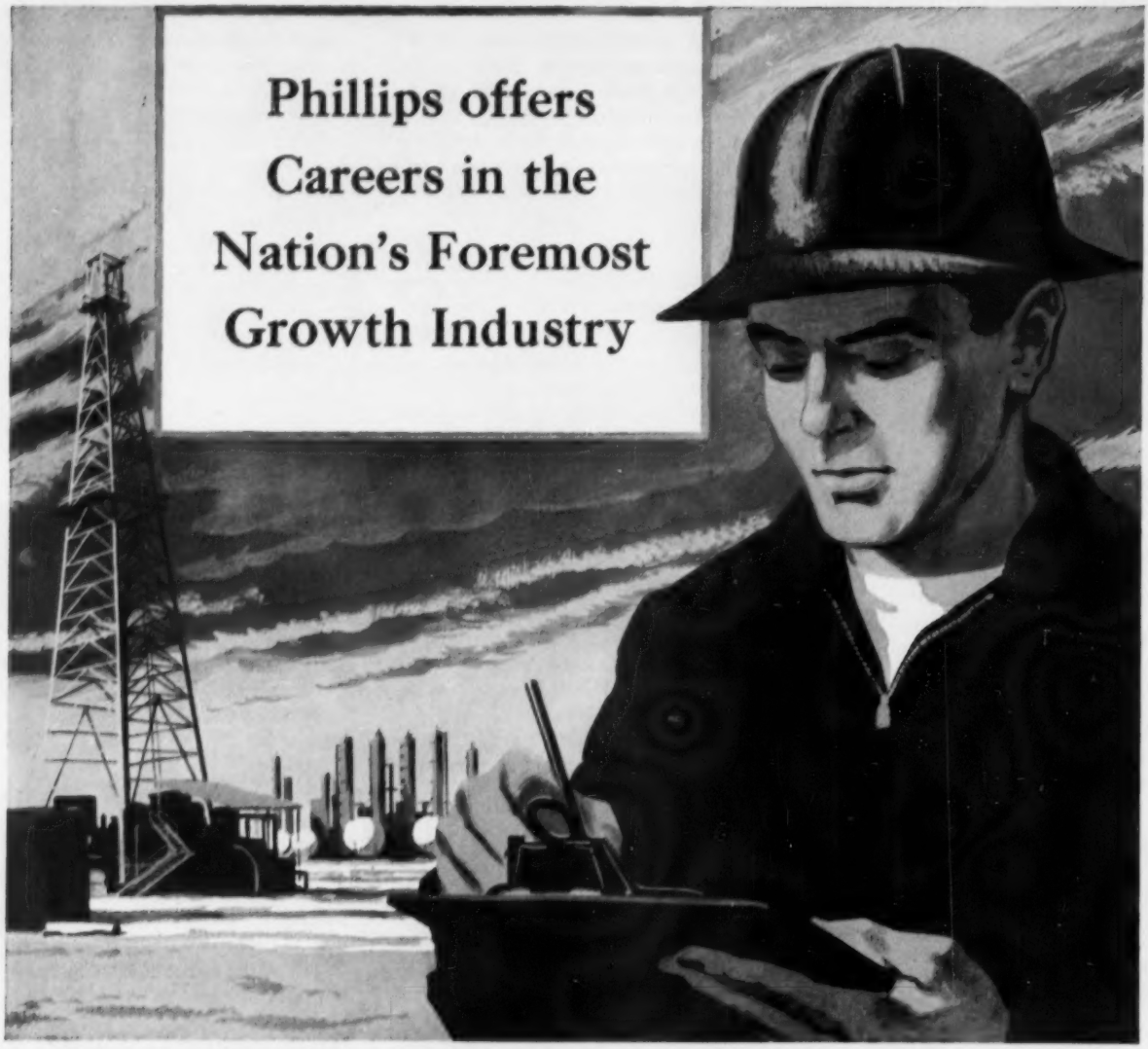

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Pilot to Navigator: "Where are we?"

Navigator to Pilot: "Due to my extensive training in calculus and trigonometry, I have calculated our position to be three miles from infinity."

• • •

We are scholars. Yes we are. We recently traced the origin of the expression, "Hurrah for our side!" back to the crowds lining the streets when Lady Godiva made her famous ride sidesaddle through the streets of Coventry.

• • •

A woman bought a $300 suit at Hattie Carnegie's and was appalled to see what appeared to be her suit at Ohrbach's for $32.50. She rushed right back to Carnegie's and told them about it. "But Madam," said the saleswoman, "the Ohrbach copy probably wasn't 100 per cent virgin wool."

"At these prices I should care what the sheep do at night?" screamed the customer.

• • •

"You can't beat the system," moaned the student after his last semester's grades. "I decided to take basket weaving for a snap course, but two Navajos enrolled and raised the curve, and I flunked."

• • •

The efficiency expert died after many years of faithful service, and his company had arranged an elaborate funeral. The pallbearers were carrying the casket out of the church when suddenly the coffin lid popped open and the expert sat up and said, "If you put this thing on rollers, you can lay off four men."

• • •

A South American was describing his country to an American woman:

"Our most popular sport is bullfighting," he told her.

"Isn't it revolting?" she asked.

"No," smiled the man, "that's the second most popular sport."

Maisie was in a bar having a beer when an English friend walked in.

"Aye say, Maisie, are you 'aving one?"

"No, it's just the cut of me coat."

• • •

A little old lady riding on the train was passing the time by working a crossword puzzle. Turning to the man beside her, she asked: "I wonder if you would help me with my puzzle?"

"I might," he replied, "what's the matter?"

"Well," the lady said, "all I need is a four letter word ending in *it*. It's something found in the bottom of a bird cage, and that the governor is full of it."

"Hmmmm," said the man, "that must be grit."

"So it is," exclaimed the little lady, "do you have a pencil with an eraser?"

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His wife lay on her death bed, pleading, "I want you to promise that you'll ride in the same car with my mother at the funeral."

He finally conceded. "O.K. But it's going to ruin my whole day."

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Thermometers: Something else graduated with degrees without having brains.

• • •

A Broadway producer was seeking to interest a dress manufacturer in backing a show. He took him to a rehearsal. One leggy lass after another appeared before him in scanty rehearsal costumes. The merchant gaped intently, but all he said was an occasional "Phooey."

The producer, annoyed, finally said, "Here I show you some of the most beautiful girls in the world, and all you do is sit there and say 'Phooey'."

"I wasn't thinking of the girls," said the merchant sadly, "I was thinking of my wife."

• • •

Best way to cure a woman of most any illness is to tell her that the symptoms are just a sign of old age.

FEMALE IN THE LAB

Atomic Weight: Reputed to be 120. Isotopes are known to exist between 90-180.

Occurrence: Found both free and combined. In combined state it is found with man.

Physical Properties: All colors, sizes and shapes. Seldom found in pure state. Boils at nothing and will freeze without reason. Surface is usually covered with film of paint or oxide in various colors and depths. Unpolished specimen turns green in presence of highly polished one. All varieties melt if used incorrectly. Density is not so great as generally supposed.

Chemical Properties: Highly explosive and dangerous in experienced hands. Extremely active in the presence of men. Possesses great affinity for gold, silver, platinum and all precious stones. Has the ability to absorb great quantities of expensive food and drink. May explode spontaneously when left alone with man. Sometimes yields to pressure. Fresh variety has great magnetic attraction, but ages rapidly.

Use: Chiefly experimental. Efficient cleaning agent. Acts as a positive or negative catalyst in the production of fevers.

Unsolved Problem: The thing that mystifies many engineers is the fact that the most streamlined specimens offer the most resistance.

• • •

Committee—A group of the unfit, appointed by the unwilling to do the unnecessary.

• • •

Put off until tomorrow what you can do today; you have made enough mistakes already.

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Marriage is like a hot bath, once you get used to it, it's not so hot.

• • •

Lecture—something that can make you feel numb on one end and dumb on the other.

• • •

M. E. on way to lecture: "I'm going with an open mind, a complete lack of prejudice and a cool rational approach to listen to what I'm convinced is pure rubbish."

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One of a series

Interview with General Electric's Hubert W. Gouldthorpe Manager—Engineering Personnel

Your Salary

Although many surveys show that salary is not the prime factor contributing to job satisfaction, it is of great importance to students weighing career opportunities. Here, Mr. Gouldthorpe answers some questions frequently asked by college engineering students.

Q. Mr. Gouldthorpe, how do you determine the starting salaries you offer graduating engineers?

A. Well, we try to evaluate the man's potential worth to General Electric. This depends on his qualifications and our need for those qualifications.

Q. How do you evaluate this potential?

A. We do it on the basis of demonstrated scholarship and extra-curricular performance, work experience, and personal qualities as appraised by interviewers, faculty, and other references.

Of course, we're not the only company looking for highly qualified men. We're alert to competition and pay competitive salaries to get the promising engineers we need.

Q. When could I expect my first raise at General Electric?

A. Our primary training programs for engineers, the Engineering Program, Manufacturing Program, and Technical Marketing Program, generally grant raises after you've been with the Company about a year.

Q. Is it an automatic raise?

A. It's automatic only in the sense that your salary is reviewed at that time. Its amount, however, is not the same for everyone. This depends first and foremost on how well you have performed your assignments, but pay changes do reflect trends in over-all salary structure brought on by changes in the cost of living or other factors.

Q. How much is your benefit program worth, as an addition to salary?

A. A great deal. Company benefits can be a surprisingly large part of employee compensation. We figure our total benefit program can be worth as much as 1/6 of your salary, depending on the extent to which you participate in the many programs available at G.E.

Q. Participation in the programs, then, is voluntary?

A. Oh, yes. The medical and life insurance plan, pension plan, and savings and stock bonus plan are all operated on a mutual contribution basis, and you're not obligated to join any of them. But they are such good values that most of our people do participate. They're an excellent way to save and provide personal and family protection.

Q. After you've been with a company like G.E. for a few years, who decides when a raise is given and how much it will be? How high up does this decision have to go?

A. We review professional salaries at least once a year. Under our philosophy of delegating such responsibilities, the decision regarding your raise will be made by one man —the man you report to; subject to the approval of only one other man —his manager.

Q. At present, what salaries do engineers with ten years' experience make?

A. According to a 1956 Survey of the Engineers Joint Council*, engineers with 10 years in the electrical machinery manufacturing industry were earning a median salary of $8100, with salaries ranging up to and beyond $15,000. At General Electric more than two thirds of our 10-year, technical college graduates are earning above this industry median. This is because we provide opportunity for the competent man to develop rapidly toward the bigger job that fits his interests and makes full use of his capabilities. As a natural consequence, more men have reached the higher salaried positions faster, and they are there because of the high value of their contribution.

I hope this answers the question you asked, but I want to emphasize again that the salary *you* will be earning depends on the value of *your* contribution. The effect of such considerations as years of service, industry median salaries, etc., will be insignificant by comparison. It is most important for you to pick a job that will *let* you make the most of your capabilities.

Q. Do you have one salary plan for professional people in engineering and a different one for those in managerial work?

A. No, we don't make such a distinction between these two important kinds of work. We have an integrated salary structure which covers both kinds of jobs, all the way up to the President's. It assures pay in accordance with actual individual contribution, whichever avenue a man may choose to follow.

*** We have a limited number of copies of the Engineers Joint Council report entitled "Professional Income of Engineers—1956." If you would like a copy, write to Engineering Personnel, Bldg. 36, 5th Floor, General Electric Company, Schenectady 5, N. Y.** 959-7

LOOK FOR other interviews discussing: • Advancement in Large Companies • Qualities We Look For in Young Engineers • Personal Development.

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